

SCIENCE DIGEST

OCTOBER 1958 15 CENTS (C.D.)

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our "poor relation"
begins to smell



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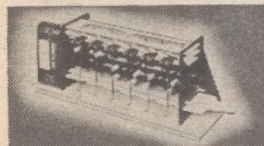
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THE DEAN of the University of Michigan's Medical School, Dr. W. N. Hubbard, made some mighty interesting remarks to a group of medical graduates not long ago. What he said, in effect, was that the right of a patient to die may, in some cases, supercede the right of a physician to attempt to extend his life by means of organ transplant or other advanced experimental operations.

THIS MONTH

"To sacrifice human dignity at the time of death, or to make the process of dying a burden upon the living, is not in the highest medical tradition nor is it justified in the humanist traditions," said Dr. Hubbard. "The physician must beware of treating his own anxiety that death represents his personal failure by unrestrained use of life-support systems."

In the light of the frightening things that are going on in the biological and medical laboratories of the world today—exemplified in the spine-tingling book, *The Biological Time Bomb*, by G. Rattray Taylor (see book review on page 88)—Dr. Hubbard's comments are especially timely.

The secrets of life are, indeed, being exposed to manipulation by men, via genetics, chemistry and biology. Let's hope more sane voices like Dr. Hubbard's are added to the chorus of caution.—*RFD*

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DIGEST®

For centuries Neanderthal man has been considered a sort of apish evolutionary dead end by anthropologists and laymen alike. New evidence, however, may change some of the old theories; it's beginning to look like Neanderthal was not a primitive dolt after all—but an intelligent, maybe even sensitive ancestor of modern man. See page 13.

Painting by Charles R. Knight,
American Museum of Natural History



OCTOBER • 1968

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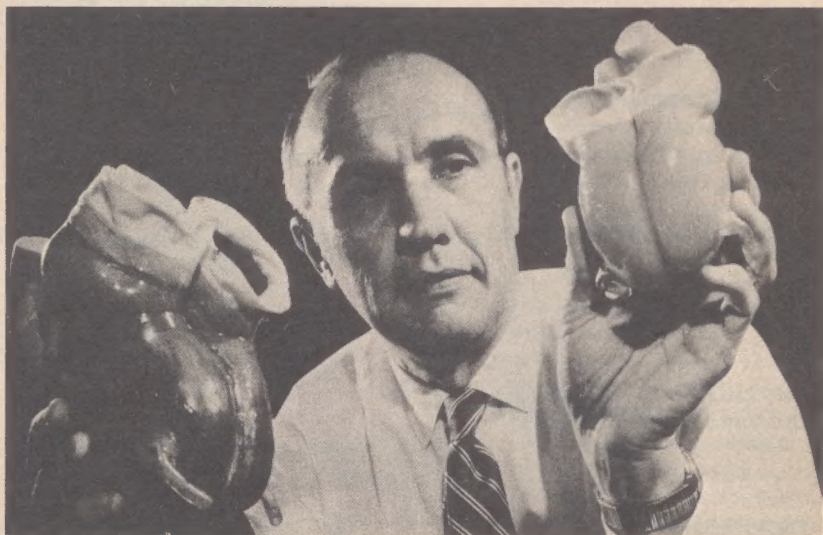
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Bulletins at press time



U.P.I.

SHRINKING HEARTS. While heart surgeons have been busy transplanting live organs in heart trouble patients, industry hasn't been idle. Latest is a streamlined, human-size synthetic rubber heart that operates mechanically. It was produced recently by Goodyear Tire and Rubber Company, perfected from earlier outsize model shown at left, above. The new one can be enclosed in the body just like a normal heart; has the advantage of minimizing danger of tissue rejection, a major hazard of live transplanted hearts.

GRAVITATIONAL ANOMALIES POSE MOON LANDING THREAT. The "seas" of the moon are natural landing areas for the Apollo astronauts. But a preliminary analysis of the data collected by Lunar Orbiter 5 a year ago, recently reported in Science, reveals that whenever the satellite passed over the Sea of Serenity, Mare Ibrum or any of the other large flat areas, it speeded up -- indicated a gravitational tug. This suggests vast bodies of dense material beneath the surface, and bears out the theory that the moon's craters were created by impact with giant bodies of nickel-iron that buried themselves and caused molten material to

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spread out above them, flooding vast plains beyond the crater rims. Scientists fear this may create problems for the Apollo explorers, who could be pulled into landing errors of up to six miles, dumping their LEM on hazardous terrain.

BUGS AND MID-AIR COLLISIONS. A huge swarm of insects flying at 5,000 feet altitude may have caused the mid-air collision of a Convair liner and a private plane last summer. The pilot of the airliner, who landed safely with the small plane buried in his twin jet's fuselage, reported to federal air safety investigators that he flew through a dense cloud of insects early in the flight. They accumulated on his windshield like ice crystals, he said, blotting his vision completely for a time. On the theory that the small plane may have been flying blind, due to bug juice, investigators are still hunting for bits of its windshield. They're also examining past records for hints that swarms of bugs may have been to blame for other mid-air disasters.

ELECTRO-CHEMICAL PEOPLE-SNIFFERS SPOT ENEMY. The Army has been using its "people sniffer" (Science Digest, Aug., 1967) to spot the Vietcong in jungle hideaways. The device, which reacts to amonia vapors exuded from human bodies, picks up "people scent" from low-flying helicopters. Smoke pots are tossed out to mark the encampments, and aircraft are called in to do the rest. The colonel in charge calls the people sniffer "the greatest thing since women."

MYSTERIOUS CLOCKS IN SPACE. Those perplexing pulsars that have baffled astronomers ever since the first one was picked out of the void get more mysterious all the time. Recently, skywatchers have been timing their pulses and it turns out that their radio signals "tick" with clocklike accuracy that errs less than one second in 30 million years. Last summer, astronomers turned up five new ones ticking away, bringing the total to nine now known. Their pulse rates vary from a steady .25 to two seconds. Because of their super accurate signals, some far-out thinkers have suggested they may be navigational signals for a supercivilization of space travelers. Astronomers say "No," since they reveal no other evidence of intelligent control.



U.P.I.

Dress rehearsal for Apollo spaceflight this month includes drilling astronauts Walter Schirra, Donn Eisele and Walter Cunningham in capsule recovery procedures at sea.

Earth lab for hostile moon microbes

Our three returning moon explorers will be flown, encapsulated, to a virus-impervious desert port, where moon samples and men will undergo weeks of tests in quarantine.

by Robert L. Davidson

WITHIN THE NEXT FEW WEEKS, a space flight unlike any other to date will blast off from Cape Kennedy. Astronauts Walter Schirra, Donn Eisele and Walter Cunningham will orbit the earth in the first manned Apollo/Saturn, sitting atop the most powerful and complex rocket system we have. Mission: dress rehearsal for man's most ambitious quest—exploration of the moon by 1970.

Myriad problems of the actual moon flight itself—radiation, pro-

longed weightlessness, intricate systems for earth and moon orbit, moon landing, takeoff and safe return have all been worked out in detail. They are hair-raising enough, but they are only half of it.

Scientists hope that samples brought back on the final flight will help solve the age-old mystery of the moon—and possibly of the universe itself. But there will be hazards, not the least of which is the risk that specimens of moon soil and rock will be laden with dangerous, unknown moon-based spores, bacteria and viruses against which

earth creatures—including people—have no natural immunity, and that our lunar probes will also be unwitting hosts to such potential dynamite.

Moon life or not, dangerous or benign, the National Aeronautics and Space Administration (NASA) has readied an \$8.1 million reception center—the Lunar Receiving Laboratory (LRL) at Clear Lake, just south of Houston, Texas. Micro-stowaways from the moon cannot escape this laboratory. Likewise, earth-bound life forms won't contaminate moon samples before they are analyzed. In this rigidly quarantined 83,000-square-foot safety

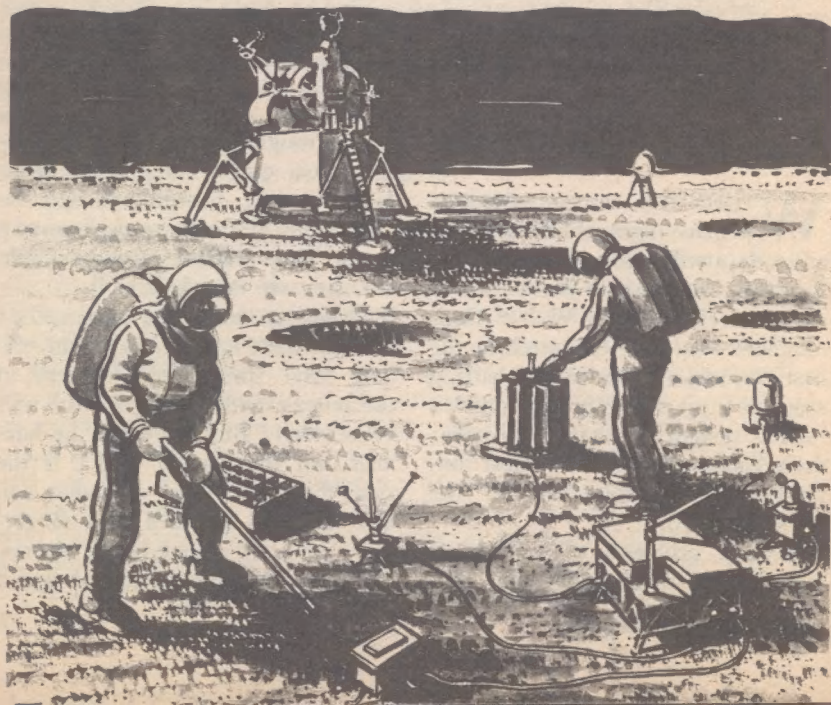
laboratory, men and moon stuff will tell their tales.

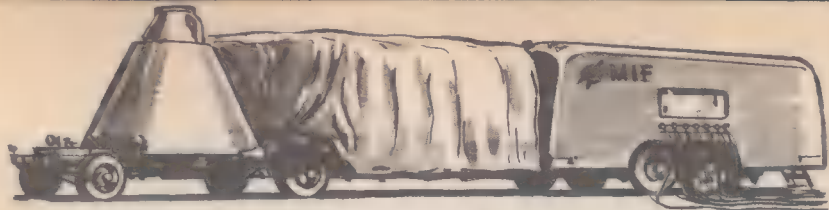
Lunar samples are one of the most important scientific purposes of the Apollo program. The technique for ultimately putting men on the moon to collect them has been thoroughly planned. While one astronaut orbits the spaceship around the moon, the other two will land on the lunar face in a Lunar Excursion Module (LEM).

The moon-based astronauts will have two major assignments. First they will place an instrument package on the moon's surface to transmit data back to earth for a year after the trip is over. Seismometers

Instrument package holding seismometer and magnetometer for lunar analysis will be placed by astronauts. Package will have enough power for one year of data transmission.

Drawing by George Blow





Drawing by George Blow

Plastic tunnel joins capsule to mobile trailer to prevent escape of alien micro-organisms into earth's air. Quarantined astronauts stay in trailer until receiving lab is reached.

will listen for telltale sounds beneath the surface; magnetometers will measure data about the layers of the moon's surface.

Assignment two is geologic sampling. Observations will be made, and 35 to 50 pounds of surface materials will be collected and stored in vacuum-sealed aluminum containers.

On the expedition's return, scientists from all over the world will subject the material to batteries of controlled tests. Hopefully, the results of these studies will provide us with clues to the nature and origin of the moon.

To make sure that there are no slip-ups, rigid procedures have been worked out painstakingly.

Lunar samples, photographs, tapes and other flight items will be rushed from the recovery aircraft carrier to the Lunar Receiving Lab by jet. The three astronauts will transfer through an airtight plastic tunnel from the Apollo command module into a special quarantine trailer.

A physician and an engineer will be in the sterile trailer to take air and scrape samples from the command module and to help the Apollo crew as it services the spacecraft. Initial medical observations will be made at this time. The five men will stay in the trailer until it

reaches the LRL complex.

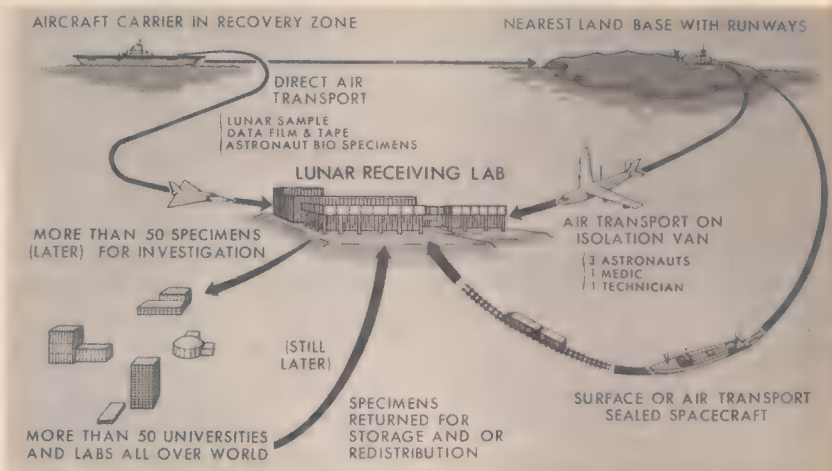
In port, the trailer will be hoisted intact aboard a cargo plane for the flight to Houston. Time from splashdown to arrival at the LRL will be five days or less. During this time, air leaving the trailer will pass through a special air-conditioning system with biological filters. Liquid wastes will be held for later sterilization and disposal.

At Houston, the crew and support personnel will enter the LRL via another plastic tunnel, there to remain for the remainder of their 21-day quarantine.

Once vacated, the Apollo module will be sealed. On its lunar orbit it will not have touched the surface of the moon. Any accidental contamination will be destroyed by high temperature as the capsule re-enters the earth's atmosphere. At the LRL, the Apollo module will be held in a room adjacent to the astronauts' quarantine quarters. Though the room will normally be open, it can be sealed if necessary.

Construction of the LRL began early in 1966 and was mostly completed by mid 1967. Working force for the laboratory will be 175.

The three basic sections of the unique laboratory are Crew Reception (quarantined), Sample Operations (quarantinable) and Support



Apollo/Saturn astronauts' route from aircraft carrier to mobile trailer to giant cargo plane to Lunar Receiving Laboratory is shown above in the drawing by NASA.

and Administration (unquarantined). Quarantined areas have biologically sealed walls to entrap the most elusive species of life, even viruses. Used air leaving the area will be sterilized by filtration or incineration, and liquid waste will be treated and sterilized.

Are these precautions really necessary? No one knows if there is living material that might be brought back from the moon and that could set up housekeeping on the earth. Most scientists are confident that the hot-cold, waterless, high-radiation lunar surface cannot maintain life. But no one wants to risk the consequences of a bad guess.

In the Crew Reception area are living quarters for the flight crew and 15 attendants—medical doctors and technicians, housekeepers and a

cook. In addition, there are dormitory facilities for 60 more persons should an accidental spill require quarantine of the scientists and technicians from the adjacent Sample Operations area.

Special care went into the design and construction of the exterior walls, floors and ceilings of the quarantine areas. By keeping these areas at a slight negative pressure of about 0.1 inch water gauge, any air leakage will be inward, not outward. To this is added filtration of incoming and outgoing air and sterilization of outgoing liquid wastes.

At the LRL Sample Operations area, biological, physical and chemical tests will be performed on the moon samples which are brought back to earth.

Under normal conditions, sam-

ples will be kept inside containers when they are out of the Sample Operations area. Once inside the sample handling system, the samples will be kept behind biological barrier cabinets, in glove boxes and in transfer lines. Personnel will put on special clothing in change rooms when they enter. They will shower and change at day's end.

Lunar samples in the two vacuum-sealed, 2.2-cubic-foot aluminum containers will have been wrapped with biological barriers to prevent contamination on board the recovery vessel. At the LRL, to remove exterior terrestrial contamination, the containers will be washed in peracetic acid, then dried. Next they will be put into the vacuum transfer lock where the pressure will be pumped down to simulate the moon's sparse, almost non-existent atmosphere.

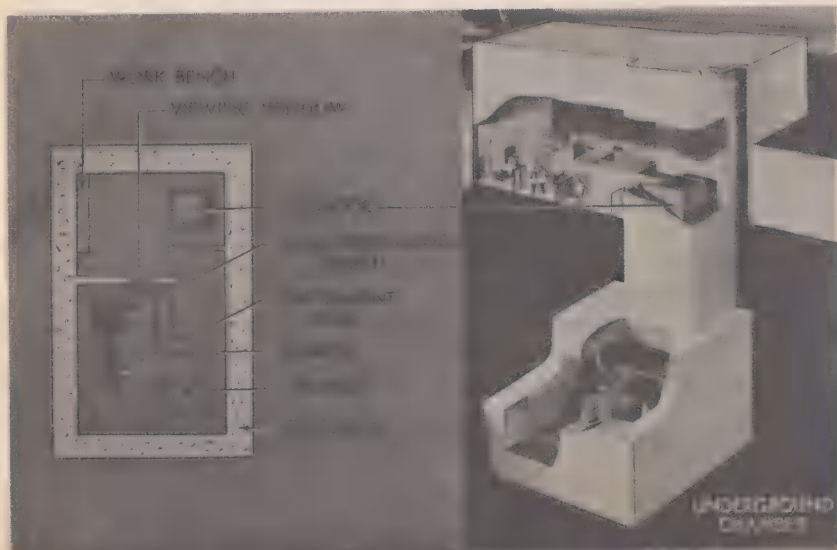
One of the more important tests planned is detection of organic or inorganic rare gases from the lunar samples. Rather than lose any moon gases during vacuum processing, the containers will be tapped for gas samples to be used later in mass spectrometer analysis.

From the vacuum laboratory, sample chips will be sent to the bioprep cabinet, then to various test laboratories. For biological testing, samples will be injected into small animals and plants to see if the lunar material contains life forms that will grow and replicate.

Included in the laboratories for biological preparation and analysis are normal and germ-free animals, plants, incubation equipment, eggs and tissue for histological studies and anaerobic and aerobic culturing.

Eleven different cell lines will be

Radiation counting laboratory is buried 50 feet underground and behind five-foot thick walls. Leaks can't penetrate interior shielding of Dunite or dense steel lining of walls.



used: human, other mammals, sub-mammalian and plant. Special germ-free mice will be used. The tiny creatures will have been born by Caesarean section in germ-free sterile environments. Consequently, they will be highly sensitive to replicative life forms.

Underground laboratory

Radiation counting of the lunar samples is to begin within 24 hours of spacecraft splashdown. Extra delay would mean the loss of any short-lived radioactive nuclei that were cosmic-ray induced on the moon.

The counting laboratory is 50 feet underground, behind five-foot thick concrete walls. Air into the area passes through cryogenic (super-cold) traps to remove radon, a naturally occurring radioactive gas of the earth's atmosphere.

The samples, in vacuum-tight custom counting containers from the vacuum system, will be checked for radioactivity.

NASA chose 113 principal investigators to analyze the lunar samples. Initial tests will be made in the isolated safety of the LRL. After sample quarantine is over, additional tests will be made at outside facilities.

Of the investigators, 47 are from universities, 28 from industrial firms, private institutions and government laboratories, and 30 are from other countries, including England, Germany, Canada, Japan, Finland and Switzerland.

After the samples have been photographed from different angles, they will be sent in small vacuum chambers to the Physical-Chemical Test Laboratory at the LRL. Here mineralogic, geochemical and petrographic tests will be performed. And to prevent surprises while handling the moon samples, they will be checked for possible adverse reactions to dry nitrogen, oxygen and air at various humidities.

The Service and Administration area of the LRL is not isolated biologically. In it are conference rooms for resident staff and visiting scientists and an extensive complex of biological support laboratories to prepare and maintain plants, animals and culture media for the quarantine replication tests.

Quick emergency check

There is an electron microscope for biological work, and laboratory equipment to cut, grind and polish petrographic thin sections for microscopic studies. A unified control will monitor the status of critical facility lab systems. Emergencies will be spotted quickly to allow immediate remedial action in cases of spills or other dangers.

What if the moon-life tests are positive? NASA officials are ready with second generation quarantine tests in the event this should happen.

The probability that any life forms will be found on the moon is slim, if theories are correct. But NASA takes no unnecessary chances.



Painting by Charles R. Knight, American Museum of Natural History

The Neanderthal Man: Is he one of us?

Neanderthal man may not have been the primitive dolt we thought he was; indications are he might even fit into modern society.

by Daniel Cohen

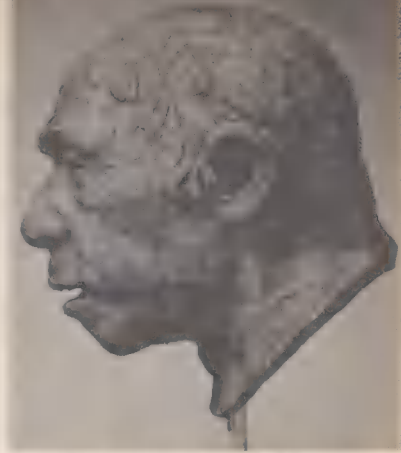
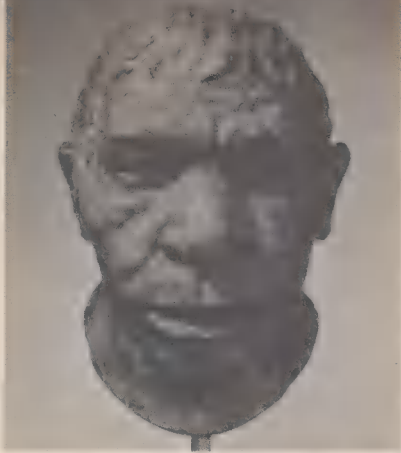
THE TIME HAS COME to reap-praise one of the most foully slandered creatures ever to walk the earth—the Neanderthal man.

Neanderthal—the German valley in which the first fossilized bones of this man were found—has almost become a byword for clumsy, brutish stupidity. Yet a recent remarkable discovery has shown that Neanderthal man must have had a sensitive, beauty-loving side.

Scientists have been able to reconstruct this picture: In the Zagros Mountains of what is now Iraq,

on a spring day, some 60,000 years ago, a Neanderthal family reverently lowered the body of one of its members into a grave deep inside a huge cave. The cave was a traditional family burying ground. The body lay on a litter of pine boughs wreathed in a multitude of colorful spring wildflowers.

Microscopic analysis of samples of pollen and flower fragments from the Neanderthal grave has revealed the presence of at least eight species of flowers, most of them small and brightly colored. Also found were fragments of a pine-like shrub. The flowers may have been woven into



American Museum of Natural History

Reconstructions of Neanderthal skulls completed recently show him as he might look clean-shaven and barbered. Heavy brows and massive facial contours are still prominent but not to the extent that previous anthropological reconstructions indicated them to be.

the branches to provide a colorful and fragrant bed for the corpse.

What other rites accompanied this ancient burial we cannot know, but scientists who made the analysis announced this discovery was "completely unexpected."

The Neanderthal burial was made in the Shanidar Cave, 250 miles north of Baghdad. In all, seven Neanderthal skeletons have been found at various depths in the cave. The skeletons at Shanidar were discovered and excavated in the late 1950s and early 1960s by Dr. Ralph Solecki, professor of anthropology at Columbia University. Those who study prehistory move at a leisurely pace; it was years before the analysis of the plant and flower fragments found in the Neanderthal grave was completed and the results published.

The pollen study was conducted by Arlette Leroi-Gourhan of the Musée de L'Homme in Paris. She contends that so much pollen from

so many different species of flowers could not possibly have accumulated accidentally at one spot inside a cave as large as Shanidar. The cave is 132 feet deep. Someone, Mrs. Leroi-Gourhan believes, must have consciously combed the slopes of the mountains to obtain such a concentration of flowers.

Discovery of the flower burial at Shanidar adds weight to an argument long advanced by an embattled minority of anthropologists and paleontologists — that Neanderthal man is a direct and perfectly respectable ancestor of man, not some sort of apish evolutionary dead end.

The common view of Neanderthal as a short, stooped, thick-necked brute is all wrong. The man found at Shanidar was approximately five feet eight inches tall, a decent height even for a modern man.

Shaved and barbered and dressed in a modern suit of clothes, Neanderthal man would probably attract little attention in a crowd at

a football game. Not everyone would find him handsome—stocky frame, big hands, massive brows and a broad, heavily featured face—not the poetic type, but not an inhuman monster either. Only if he smiled, exposing a hideously large set of heavy duty teeth, which constitute the most significant known difference between Neanderthal man and ourselves, would people become aware that there was something distinctly odd about this fellow. Large teeth necessitate a large face to contain them; that is why we assume that the Neanderthal had massive, heavy features.

Although he might pass unnoticed in a crowd, since 1856 when the first Neanderthal bones were discovered in Germany, modern man has been trying to deny a close relationship to such a creature. The fragmentary German skeleton was quickly recognized as being quite unusual, but in 1856 there was no way of determining how old it was. Certainly no one could have guessed that it was 40,000 years old, as we now assume it to have been. The publication of Charles Darwin's *Origin of the Species* was still three years in the future.

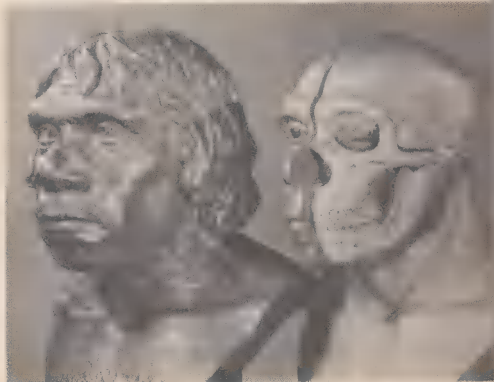
Many, including some of the world's most learned medical scientists, explained the peculiarities of the Neanderthal skeleton as being the result of any one of a number of pathological conditions. Others reacted according to the prejudices of the day. According to a German scholar the skeleton belonged to an "old Dutchman." A French scholar

saw it as a sturdy Celt, like "a modern Irishman with low mental organization." Yet another scholar explained the apparently bent legs of the skeleton as the result of a lot of horseback riding, and wrapped the whole thing up by asserting that the skeleton had belonged to a member of the Russian Army which had pursued Napoleon out of Russia and through Germany in 1814—more specifically it was the skeleton of a Mongolian Cossack who suffered from rickets.

But as more skeletons of the Neanderthal type turned up, it became increasingly difficult to explain the bones in ordinary terms. By the beginning of the 20th century the idea of evolution had become established in scientific circles. Scientists, notably those in Germany, came to a seemingly logical conclusion—Neanderthal man was an evolutionary

Earlier theories proclaimed Neanderthal an apish evolutionary dead end; reconstructions (below) of large preorbital ridge and heavy facial contours are exaggerated.

American Museum of Natural History



precursor of modern man.

Shortly thereafter, however, this straightforward view was challenged by French scholars led by Marcellin Boule of the National Museum of Natural History in Paris. Boule contended that the Neanderthal was a side branch of human evolution, far too divergent from the mainstream to be considered as our ancestor in any sense.

Unsightly ancestor

There developed the pleasing notion that all our ancestors were the tall, straight, handsome, fully modern specimens represented by the remains found at Cro-Magnon in France. Fossil bones and teeth can give us only the most general notion of what either Neanderthal or Cro-Magnon man looked like. Reconstructions which give elaborate detail of facial features and expression and even skin color are at best guesswork which reflects the training and prejudices of the artist. Thus Neanderthal is usually made to look brutish and primitive, while Cro-Magnon comes out more the handsome noble savage type.

Modern man, the theory runs, developed "somewhere in the East." Then armed with superior intelligence and superior weapons, the handsome and noble modern type invaded Europe and exterminated the simple, brutish, culturally stagnant Neanderthals.

Where did such an idea come from? The supporting facts are meager, says C. Loring Brace, one

of the few anthropologists today who is attempting to refurbish Neanderthal's tarnished reputation. Writing in a recent issue of *Natural History*, Brace points out that the term "evolution" in France had quite a different meaning than in Germany and England. "... Instead of meaning descent with modification by means of natural selection, the concept of evolution was so similar to the theory known as 'catastrophism' — featuring extinctions, invasion and successive creations supported by (Georges) Cuvier during the first third of the 19th century—that it largely amounted to a relabeling of the earlier view."

The view which saw Neanderthal man as a direct step in the evolution of modern man was largely represented by German scholars. But after World War I the reputation of German scholarship suffered badly. Therefore Brace concludes, "Two subsequent generations of professional students of human evolution have grown up schooled to believe that the prehistoric Neanderthals were a peculiar group (who died out) because of their failure to adapt."

What evidence is there for assuming that Neanderthal man was an evolutionary failure? There is no evidence that he was stupid—indeed it is a bit embarrassing to note that the average size of the brain chamber of Neanderthal skulls is somewhat larger than that of modern man—1600 cubic centimeters as compared to 1450 cubic centimeters.

Even before the discovery of the

*Neanderthal was a skilled maker of tools;
evidence shows he adapted well to his environment.*

flower burial at Shanidar, scientists knew that Neanderthal man had some sort of concept of an afterlife—numerous careful burials attest to this. From 1917 to 1921 Swiss scientists excavated a cave which had apparently once served as some sort of religious center for a Neanderthal cult involving cave bears. Cave bear bones and skulls were laid in niches or stone chests and were arranged in deliberate order and carefully covered with stone slabs. The scientists found that Neanderthal man had beheaded the bears and buried the heads whole. Similar discoveries were made in other caves. The significance of the “bear ceremony” can only be guessed at, but it is interesting to observe that similar ceremonies still take place among some of the more primitive peoples of northeast Asia.

Neanderthal man was a tool maker of no little skill. The types of tools he made are called Mousterian by prehistorians, and include a variety of stone axes, knives and spear points. He obviously used these tools with great effectiveness, for Neanderthal sites are littered with animal bones, including those of giants like the mammoth.

As for Neanderthal man's appearance, we may not like it, but it did not necessarily put him at an evolutionary disadvantage. “Why,” asks Brace, “is it disadvantageous to be extraordinarily robust and to

possess heavy brow ridges, faces and teeth. . . .” The huge teeth probably were a useful tool. Today among some primitive peoples like the Australian aborigines, the teeth still serve as important tools.

Neanderthal man was nothing if not adaptable. He came into existence before the ice ages, and lived right through them. He did not migrate south in front of the advancing ice sheet; he went on living where he had been and adapted to a vastly changed environment successfully. Why would this adaptable, intelligent species simply fold up in the face of an invasion “from the East”?

That brings up the misconception that Neanderthal was a specialized European species. This notion should have been abandoned a long time ago. In the 1930s, an important find of Neanderthal bones was made in caves on the slopes of Mt. Carmel in what is now Israel. The flower burial, and six other Neanderthal skeletons, were found in Shanidar, which is in Iraq. Indeed the bones of Neanderthal men, or creatures very like Neanderthal men, have been found all over the Eastern Hemisphere. Only the Americas, Antarctica and Australia have failed to yield any Neanderthal fossils.

What is Neanderthal man then? Today the general belief—held even by those scientists who want to consign Neanderthal to the dustbin

of evolutionary history—is that he was so similar to modern man, *Homo sapien*, that the two could interbreed and produce fertile offspring. (Interbreeding between two distinct species may either be impossible, or produce sterile hybrids.) Thus while Neanderthal's scientific name once was *Homo neanderthalensis*, which marked him off as a species separate and distinct from man, he is now generally classified as *Homo sapien neanderthalensis*, a sub species of *Homo sapien*.

Well then, what happened to the Neanderthal man? Why don't we see him around anymore? The prevailing view is that Neanderthal branched off from the main trunk of the evolutionary tree some 80,000 years ago, and evolved into a highly specialized, brutish creature that lived mainly in Europe during the ice ages. He was exterminated, according to this theory, by an invasion of aggressive "modern men" from the East. The fossil evidence is far too rare and fragmentary to allow anything more than an educated guess. A new find in a cave in France or Uzbekistan could completely alter our view. Without a time machine, therefore, it will never be possible to disprove the theory of Cain and Abel warfare. But equally, there is no particular reason to believe it.

It seems more reasonable to return to the much simpler view that Neanderthal man evolved into and mixed with modern types of men. He did not become extinct through invasion or any other catastrophe.

Rather the genes of *Homo sapien neanderthalensis* had over thousands of generations so thoroughly mingled with those of *Homo sapien* that the *neanderthalensis* simply ceased to exist as a separate group.

The skeletons found on Mt. Carmel are particularly interesting in this respect. They range in appearance from classic Neanderthal to almost modern. Scientists hesitated to call them Neanderthal and coined the term Neanderthaloid. One explanation was that they were early remains of the type of man which eventually evolved into true *Homo sapien*. But modern dating techniques have shown these remains are 40,000 years old. This puts them squarely between the classic Neanderthal and modern types in appearance as well as in time. They seem very like the 'missing link' between the Neanderthal man and ourselves.

Some of the Shanidar skeletons also show a curious modernity. Were they evolving toward modern man while the European Neanderthal, trapped by the ice sheets, was evolving toward a specialized classic Neanderthal? Not necessarily. The Middle East has also produced skeletons as "classic" as any of those of Europe, in full flower of beetling brows and great teeth.

We need not feel too badly about having one such as the Neanderthal on our family tree. After all, he was sensitive enough to love flowers. Besides, if we regard him as a stoop-shouldered brute, the image is imaginary. It does not fit the facts.

Zap!

EVERYONE KNOWS about the chameleon's bizarre ability to change colors, but this tree-living reptile does a number of other unusual things that aren't so well publicized.

This unique lizard has four remarkable feet which can be placed in a line and clipped to a branch with opposing toes.

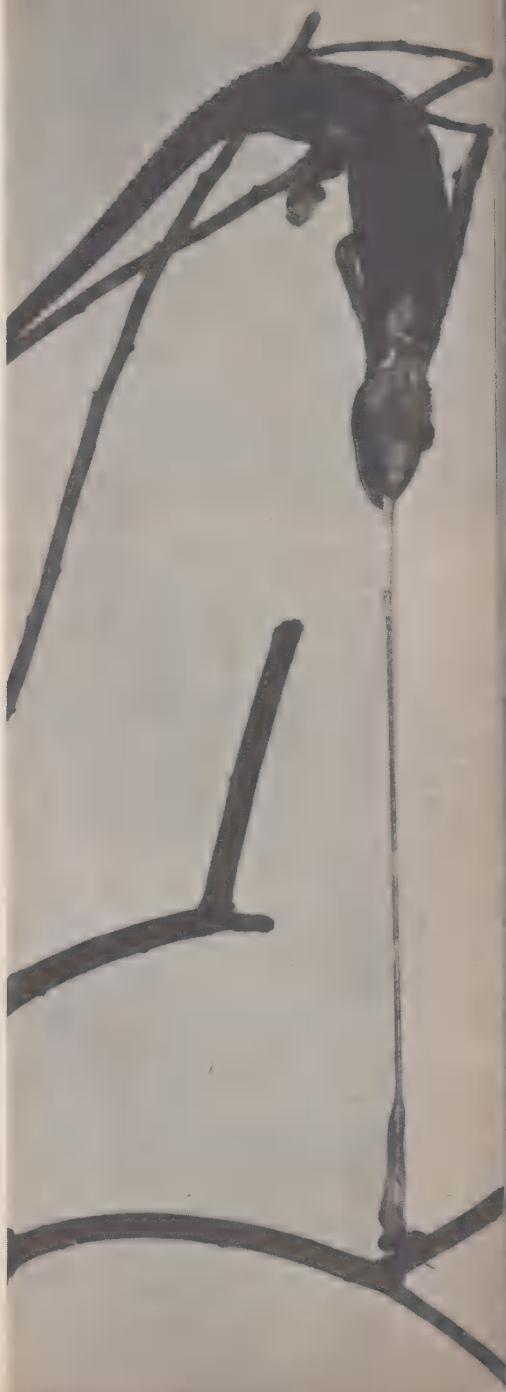
Because of its cone-shaped eyes which swivel around like gun turrets and operate independently, it can keep a possible predator in view behind it while tracking a fly in front.

Insects are the main diet of the chameleon, and it is equipped with a highly effective, sticky tongue which it uses with impressive marksmanship. With two powerful sets of muscles to control the complex tongue mechanism, this reptile can make its tongue dart out and grab a prey at an amazing distance—even as far as the length of the chameleon's body plus tail.

This strange lizard lives in Africa and Madagascar, Arabia, southern India and Ceylon. The only true chameleons in North America are found in zoos.

All photos San Diego Zoo.

The chameleon has an amazing tongue; it can be extended great distances—as far as the length of its body plus tail—in order to snatch its prey, generally flies or other insects. The tongue then retracts.



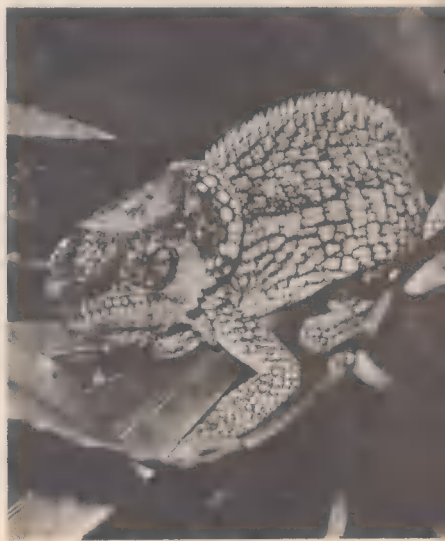


A common chameleon of the Mediterranean region (above). The ability to change color is grossly exaggerated; most quick changes occur when the lizard is frightened.

Specially adapted grasping feet and toes enable the chameleon (below) to venture onto branches too small for other animals in order to search for its insect prey.

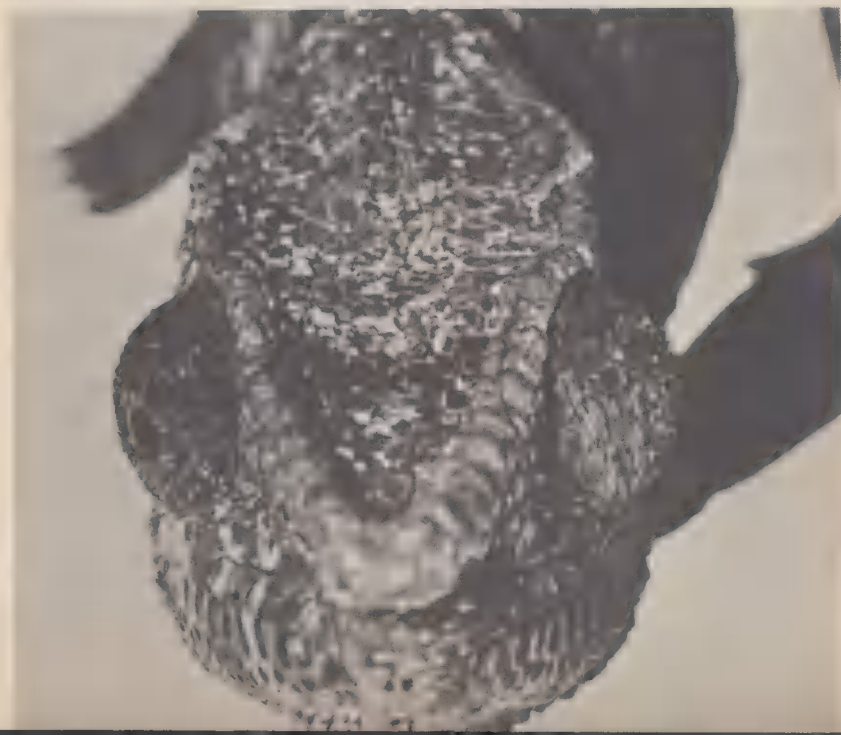


The Malagasy and African species often have spectacular horns, such as the fellow above, with three very prominent ones. Note also the grasping feet and toes.





An outstanding characteristic is the prehensile tail (above). As an aid to the grasping feet, the tail can be wrapped around a branch and used as an anchor for the lizard. The chameleon's eyes can move independently or, unlike most other reptiles', can be focused on one spot, achieving binocular vision and all-important depth perception. Eyelids are one circular fold with just the pupil showing, as pictured below.



NEW FOR PEOPLE



111PS



7





5



1. Lightning-proof tent to protect soldiers, hunters and workmen sets up in two minutes and weighs eight pounds. Technische Hochschule, Munich, Germany. 2. Imaginative nursery furniture, made of flame-proofed plywood and coated with non-toxic lacquer, knocks down and packs flat for transport or storage. Kethro Design, Shearex Plastics, Durham, England. 3. "Shock cart," compact and portable, measures blood flow, intravascular pressure and gives bedside electrocardiograms to shock patients. Honeywell Inc., Denver, Colo. 4. Flameless, fluidless, battery-operated gaslighter for ignition of all propane gas appliances has been developed by Nassau Shores H & G, Massapequa, N.Y. 5. Junk-like sails, sink-proof "bubble" hull and heroic ambition set the Galway Blazer II apart from usual sailboat. She's especially designed to catch even a whisper of prevailing wind. 6. Krypton light bulb claims three times longer life, gives greater light for volume, is two inches shorter than ordinary bulbs. Duro-Test Corp., North Bergen, N.J. 7. Telephones for deaf are being developed at Bell Telephone Laboratories, Murray Hill, N.J. Deaf will communicate by reading letters and numbers activated by push-buttons and flashed on small screen.

THE PSYCHOPATHOLOGY OF BIG BUSINESS

by Flora Rheta Schreiber
and Melvin Herman

ACCORDING to John Galbraith, "We are becoming the servants, in thought as in action, of the machine we have created to serve us." The machine is that industrial organism—Big Business. And regardless of whether or not industry has become a Frankenstein, we are faced with a "machine" that frequently backfires.

Psychiatrists today face a line of patients whose problems in many cases stem directly from their relationship to the industrial monster. Disturbances take various forms, ac-

the executive level. In one case, a young executive named Burt (that's not his real name) became anxiety-ridden because of a decision he was forced to make concerning a promotion. He liked his job; the squeak of his chair, the taste of black cof-

BIG BUSINESS HAS BECOME A

fee, the typewriter clatter were familiar and comfortable. He didn't want the promotion the company offered him.

"You're running away from responsibility," his boss said. "We've been grooming you for this job. You can't walk out on us now."

Why did this 32-year-old man with a wife and two children, reject a post that would not only pay him \$6,000 a year above his current salary and give him the status all men seem to seek, but also give him a chance to develop his own natural resourcefulness and talent?

EXECUTIVE ANXIETY

cording to the individual's personality; but most medical men who study emotional behavior agree that these problems are the result of the patients' working environment.

Most serious problems occur on

Men like Burt, according to Dr. John A. Tienor, a psychiatrist with the Menninger Foundation, suffer from what has come to be called "the promotion neurosis." "These young men," Dr. Tienor explains, "are reluctant to see themselves as the father-figure. They also fear the isolation of a lofty perch. Perhaps, too, knowing their own limitations better than their bosses do, they fear that the weaknesses they have successfully concealed in their relative obscurity will spring into full view once the spotlight is upon them. Change threatens these men.

"Promotion neurosis" is just one of many symptoms in the mammoth arsenal of today's big business. Men develop neuroses and psychoses not

librium before its members can achieve mental health. According to Dr. Tienor, "Everyone must find his particular mental balance—one that is suited to his special personality as expressed by his ego, his

PROMOTION NEUROSIS

conscience and his fundamental drives." Freud, it will be remembered, called these elements ego, super ego and id.

Burt actually used his "promotion neurosis" to maintain his inner balance. He did far better than four

MACHINE THAT IS OFTEN OUT OF CONTROL

only because of what happens to them in their private lives, but also as the result of where, how and with whom they work. "As work is today the central organizing point of a man's life," declares Dr. Harry Levinson, director of the Menninger Foundation's Division of Industrial Mental Health, "where and how he works affects his mental health."

Each company, too, like each family, develops its distinctive personality and its particular psychopathology. The company, as well as the family, is like a delicate machine which must find its equi-

other men faced with similar choices. Henry—a man Dr. Tienor describes—allowed himself to be pushed into a higher post although he didn't really want it. As a result he became physically ill, and it was not until he was demoted that his symptoms cleared up. Only with demotion could he again become the highly effective executive he had been before he changed roles.

Another man who accepted the promotion he feared discovered that he couldn't do the job, and quit. Another, putting on a big show about how much he valued becom-

ing part of the higher echelon, was secretly as fearful of it as were the other three. His panic found an outlet in excessive drinking. He became "the drunken big shot." Still another man, promoted beyond his desires, did make good, but only by working a 16-hour-day and sacrificing family and friends to his job. All of these men were in psychological trouble because their inner needs conflicted with the values of success set by their companies.

Business generation gap

The conflict many men in industry suffer is what we might call the conflict of the business generation gap. Al, the executive-vice-president of one of the 500 really big firms in the United States, was, at 58, full of vigor. He played golf in the low 70s, still bested his opponents on the tennis courts and could swing until dawn at the discotheque. At home, however, he was restless and remote, showing definite symptoms of an inner disturbance. A tough curmudgeon in his firm, he refused to accept the new ideas that younger men in the company brought there.

One day Al marched into the office of the firm's psychiatrist to announce, "I'm as obsolete as a kerosene lamp. I don't know anything compared to the young squirts who are coming up. I go to every seminar I can, sit up half the night reading trade journals, but I still don't have the foundation these youngsters have. I can see the scorn in

those boys' eyes. I'm old, finished, useless. I'm just serving time."

Even the latest Ph.D. on the payroll shares Al's concern. Next year or next month a new scientific development can leave him behind. Industry is in a headlong rush to dish up the newest. Many say now that there are no market questions for the biggest firms—they are driven only by their desire to serve science and technology.

The company's psychiatrist, knowing these things, advised Al to "let up." "Get yourself a first-rate assistant and prepare for retirement," he was told.

Al not only followed the advice, but also set about developing outside interests. He even ran for office in his small suburban community. At the same time he clung to the conviction that something must be done to alter a situation whereby men like him are called upon to make decisions in a world that quite literally passed them by the day they joined the management team.

Retirement is not necessarily the solution for most men. And Al, sitting out the days until retirement, guarding his job and the status quo, surely can be a contribution to psychopathology.

Even the men who are at the very top of the executive ladder often find they can't control the circumstances leading to emotional prob-

Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric Hospitals.

Has big business become a Frankenstein that dehumanizes its executives and labor force?

lems for their employees. The head of a virtual kingdom greater in size than that of any fabled monarch of history, the president is nevertheless the head in name rather than in fact.

Mr. President is quick to protest, "If there is any psychopathology in my business, it is not due to me personally. I'm just a member of the management team. I can't even make a decision on my own. Everything is done by committees. I have no power to change this system once it is established.

"We are not a big firm," he adds, "because we like bigness, but because only a very big firm can make use of the new technical and scientific improvements."

The end result is dehumanization. The individual becomes a servant to "the machine." Essentially it is this facelessness that is the mainspring of psychopathology of today's big business.

"The organization," cautions Dr. Levinson, "need not be destructive to the man. In fact we think it can foster his psychological health. An employee wants the organization to help him develop, and he wants to do a good job. But when the organization does not encourage this growth, he can only withdraw from it in self-defense."

Withdrawal is more likely among workers of low skills. The lower a worker's skill, the less chance that

anybody in the company cares about him. He is not involved in any kind of decision-making and is not entrusted with any responsibility. The result is that he has no real psychological investment in what he does.

The way people feel about themselves is directly related to their work. Conflict can be built into work situations by the way in which the work flow is arranged, production is scheduled or decisions are made. Low morale and poor mental health are often the result of the self-image of the employee or the effects of his inability to make an identification with the end-product of his labors and his distance from management.

Indirect destruction

Industry, as constituted, can indirectly destroy men. One recent startling case involved the most active man in a leading company. He was the man who undertook the toughest assignments, licked them in jig time and came back asking for more. One day, however, he confronted the president with a surprising announcement, "I'm slipping," he told his boss. "I've lost the confidence of my men." Later, when the president checked, he discovered that the man had been late with reports during the past month. This was completely out of charac-

ter. The president learned, too, that he had quarreled with some of his colleagues.

It was only a matter of a few weeks before the troubled man raised a small caliber revolver to his temple and put a bullet into his brain.

Like all persons who are confronted with a suicide in their midst, this man's colleagues felt guilty about it. The president thought that perhaps he could have made the job less demanding. Yet it was the man who had made his own demands. He had done so since he was a child. Only by driving himself could he live with himself. Completed jobs gave him no satisfaction. Relentless with himself, he was driven to go on. No matter what he achieved, he saw himself as inadequate.

Industrial blind spots

According to the late Dr. Will Menninger, men like that are the victims of industry's psychological blind spots. "Many industrial leaders," he maintained, "have blind spots for the psychological facts of life. With very few exceptions, industries have never set up any kind of research programs in the psychology of the people working for them." He added, "Men in industry have to learn to accept the validity of psychological data. We give lip service to such data, so much so that most people regard themselves as amateur psychologists. Rarely, however, do we study the data." It was also Dr. Menninger's conten-

tion that "we must learn to operate on the concept of personality which, most simply put, is all that a man is, all that he has been and all that he hopes to be." Dr. Menninger believed industry must take cognizance of the fact that we are all different, and our differences are an extremely important aspect of the work we do. "The greatest need in industry," this world-famous psychiatrist declared, "is many understanding men. Such men must acquire the knowledge upon which such understanding is based."

"Each of us," according to Dr. Tienor, "expresses his problems by acting on the environment. Every man cannot do every job. Industry must always allow for individual differences. People can change, but so can industry."

The consensus among these experts of the famed Menninger Clinic is that a therapeutic balance must be found for industry's over-all dehumanization.

"Men in industry should not, of course, become amateur psychiatrists, but they cannot ignore the need to know about personal and group behavior and motivation," adds Dr. Menninger.

As Big Business becomes bigger and more complex, the problems of the men who are swept along in its wake will become bigger and more complex. And if we are ultimately to be masters, not servants, of the "machines" we create, industry—whose eyes are so often fixed on the stars—must occasionally look at the man.

Columbus' ships? — X marks the spot

CHRISTOPHER COLUMBUS was a disillusioned man when his last two ships, riddled by toredos and badly leaking, limped into a Jamaican bay in 1503. Of four caravels, two already had been abandoned—one trapped in an Indian battle; the other left to rot on the Caribbean coast of Panama.

It was in St. Ann's Bay on the northern Jamaica coast, historians have believed, that the last of the explorer's ships, the *Capitana* and the *Santiago*, sank. And there they lay, for 400 years.

Was St. Ann's Bay *really* the place? Recently, an American underwater explorer and treasure hunter, Robert Marx, was on a treasure-hunting holiday in the area. In St. Ann's Bay he brought up pottery that has been dated by the Jamaica Institute as Columbian. Bits of timber, too, have been checked out as Columbian in carbon 14 tests.

Now archaeologists are all excited. If these *are* Columbus' ships, they're optimistic about freeing the caravels from their centuries-old tomb of muck and sediment.

A few weeks ago, Frederic Dumas, an associate of the famous underwater explorer Jacques-Yves Cousteau, set out with an expedition to probe the bottom of St. Ann's Bay with high hopes of bringing up the ships.

The French archaeologists do not expect to find treasure in any monetary sense; Columbus' career had come to complete fiasco at this point. The real treasure, should theories prove true, exists strictly in archaeological terms.

Special preservation measures will be necessary to prevent the quick disintegration of the sunken vessels. If certain structural parts of the ships are recovered—keels and ribs which indicate the curved lines of the caravels—archaeologists will be able to make authentic reconstructions of the vessels that were used by Columbus in his four voyages to the New World.

The *Capitana* and the *Santiago* carried Christopher Columbus' hope to the bottom of that bay in the Caribbean. Perhaps something remains of what he dreamed about that archaeologists can save.

Map by George Blow

X marks the spot where French archaeologists hope to find some remains of Christopher Columbus' last ships, the *Capitana* and *Santiago*, which sank in 1503. Historians have long believed St. Ann's Bay to be the spot where the ships sank; now the archaeologists hope to find proof.





ULCERS

Ulcers are still a medical mystery; nobody is sure why people get them or why some are susceptible and others are immune to them.

IF THE NEXT EDITION of your daily newspaper carried a front page story telling you that President Johnson had developed a peptic ulcer, you probably wouldn't be surprised. Look at the impossible

job he's got, you'd say; the worry, the tension, the decisions he has to make. No wonder he's got an ulcer!

Many of us have a pretty clear picture in our minds of the kind of people who get ulcers. Like the

President, they're faced with tremendous responsibility. They're heads of large companies, advertising executives, millionaires, television producers. They're young businessmen hustling to get ahead, or people with so much drive they'll let nothing block their way on the road to success.

This stereotype of the ulcer sufferer may be the favorite of TV shows, novels and popular opinion, but it's about as scientifically valid as the assumption that eating spinach will make you big and strong. Indeed, people at any age and in any occupation can and do get ulcers.

Ulcers are still a medical mystery; nobody is sure why people get them or why some are susceptible and others are immune. Theories abound, yet scientists know just one thing for sure about the cause of ulcers—they occur only in people whose stomachs secrete hydrochloric acid in their gastric juice—and the stomachs of most people do secrete this acid. A peptic ulcer forms when these juices eat into the wall of the stomach or duodenum, and studies suggest that ulcers will not form in the absence of the hydrochloric acid.

The popular version of an ulcer sufferer seems even more foolish when you take a look at statistics on the prevalence of the disease. Today, an estimated five million Americans have ulcers, a figure far exceeding the number who fit the ulcer victim stereotype. Every day, ulcers claim about 4,000 new vic-

tims, and it's estimated that between 7 percent and 12 percent of our population will be afflicted with the disease in their lifetime. In 1965, peptic ulcers ranked 12th as a cause of death in this country, and it accounted for about 10 percent of all adult admissions to general medical and surgical wards. (About 150,000 ulcer patients require surgery every year.)

The economic impact of the disease was made clear in the U.S. National Health Survey of 1957-59. "Ulcers are most prevalent in adult males, and thus they have an effect on the economy of the nation out of proportion to their prevalence in the total population," the report notes. The statistics are impressive: (1) 14 million workdays were lost during each of the two years covered; (2) on an average workday, 49,000 of the usually working people were absent; (3) the average number of workdays lost for each man (45-64 years of age) with a peptic ulcer was 12.4 each year.

What are ulcers? A peptic ulcer is a small, shallow crater in the stomach or in the duodenum, the beginning of the small intestine. An ulcer starts with a small break in the mucous lining that protects the stomach and intestinal walls.

Once an ulcer appears, it is irritated by gastric juice. Unless the ulcer is treated, this irritation may prevent it from healing. Gastric juice is so strong the stomach can

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digest nearly anything and would digest itself if given a chance, but its mucous lining prevents it from doing so.

An ulcer can eat into a blood vessel and cause bleeding in the digestive tract, a condition requiring immediate treatment, sometimes by surgery, to keep the patient from bleeding to death.

Inflammation and scarring around an ulcer sometimes block the pylorus, the exit from the stomach, preventing food from passing to the intestines. If the inflammation can't be relieved with other measures, surgery may be necessary.

Ulcers of the duodenum are the most common. The stomachs of duodenal ulcer victims often produce three to twenty times as much gastric juice as the empty stomachs of normal people. Ordinarily, when the stomach is empty, very little acid is produced. But in most duodenal ulcer patients, acid is secreted even between meals.

On the other hand, most gastric or stomach ulcer victims have a normal amount of gastric acid. Sufferers from stomach ulcers are usually older people in whom the secretion of gastric juices is the same as, or even less than, that of normal people. But even this amount can't be tolerated by those prone to stomach ulcers.

The classic ulcer symptoms are ■ burning pain in the upper abdomen, which varies from mild discomfort to a severe gnawing sensation. Patients have frequently described it as a "real bad hunger pain" that

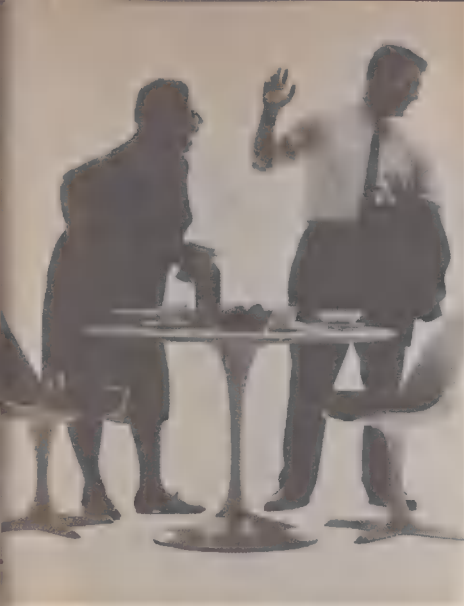
sometimes spreads to other parts of the abdomen or to the back. It usually is absent before breakfast, reappears one to four hours after meals and often is severe enough at night to awaken the patient. Other ulcer symptoms may include vomiting and excreting blood.

Although scientists can't say for sure what causes ulcers, they suspect there's a relationship between ulcer formation and emotional stress, heredity, diet and environment.

Many investigations have linked

Deaths from gastric ulcers are not uncommon in Japan, where it's customary to drink as many as 20 cups of hot green tea daily. Highly spiced or low protein food is also thought to be ulcer promoting.





Emotional stress seems to be one of the major causes of ulcers, and many doctors feel that if an ulcer victim can eliminate the underlying problem he will be well on his way to eliminating the ulcer.

stress to ulcers. In 1958, for example, scientists at the Walter Reed Army Institute of Research were teaching monkeys to avoid electric shocks by pressing a lever. The researchers were baffled when a large number of the animals died. Results of the autopsies showed that the animals had perished of ailments very unusual in laboratory monkeys—ulcers and gastrointestinal damage.

Had the electric shocks caused the ulcers? To find out, the scientists paired off some monkeys so that each of them would receive a shock and only one of them could avoid it for both of them by pressing a lever. Those monkeys faced with making the decisions soon learned that they could avoid being shocked by pressing their levers as

often as 20 times a minute. After three weeks of this schedule, the decision-making monkeys died of perforated ulcers. Their partners remained in good health.

In this instance, it seems logical to conclude that stress played a part in causing the ulcers, but if it did, researchers don't know exactly how.

Under stress, both animal and human stomachs excrete excessive amounts of gastric juice. Studies have shown that in patients with ulcers, resentment and anger cause increased secretion of gastric juice, marked increase in stomach contraction and a generalized increase in the flow of blood through the mucous membrane of the stomach and duodenum. But other tests have demonstrated that, under stress, the same changes take place in the stomachs of people without ulcers.

Although many studies have shown a relationship between ulcer disease and stress, none of the findings point conclusively to stress as the only cause.

The hereditary factors in ulcer proneness aren't fully understood, but it's pretty clearly established that a person is likelier to have them if his parents, brothers or sisters have them.

In addition, it seems that people with Type O blood get ulcers more often than those with other blood types. So do people whose salivary secretions lack certain substances. Since these are genetic factors, they may be further evidence suggesting that ulcer proneness is inherited.

Ulcers afflict all ages and can oc-

cur even in the newborn. But they're relatively rare in the young; less than 5 percent occur under age 24. Ulcers are most frequent in the decade between ages 35 and 44, and more than half the ulcer patients in this country are over 45.

There's no clear proof, but some doctors believe diet and medication can play a part in ulcer formation. Rheumatoid arthritis patients may sometimes develop ulcers because the aspirin and steroids they take to relieve pain can break down the stomach's lining. It's been reported that wine, liquor, coffee, tea, highly spiced or low protein food and smoking are also ulcer promoting.

Too much tea

According to a report in the February 1963 *Archives of Environmental Health*, deaths from gastric ulcer are more common than from duodenal ulcer in Japan, where it's customary to drink as many as 15 to 20 cups of very hot green tea daily. Hot rice and rice patties make up a great part of the diet; very little protein is eaten.

In southern India, where people eat a low protein diet, duodenal ulcer is quite common. In the Punjab region of India, where the diet is good and rich in protein, duodenal ulcer is much less frequent. These facts indicate that poor nutrition probably contributes to the formation of ulcers.

Although no one has found a good way to prevent people from getting ulcers, the ulcers themselves

can be healed. In most cases, proper diet, medication and a relaxed way of life will help heal an ulcer.

Doctors also urge ulcer patients to stop smoking and drinking coffee and alcohol, and even after the ulcer has healed, they should limit their use of them. Except for alcohol and coffee, though, most patients can then safely resume a reasonably liberal diet.

Tranquilizers are often prescribed in ulcer treatment. They are sometimes combined with drugs that are used to reduce acid formation by the stomach.

Generally, the victim of a peptic ulcer should try to change his way of life. An ulcer is a chronic disease that will usually heal but is likely to recur. With proper therapy, however, an ulcer can be controlled. In most cases of uncomplicated ulcers, healing takes six to eight weeks, but 80 to 90 percent of ulcer victims have recurrences.

Since ulcers and emotional stress seem to be so closely related, many doctors feel it's important to discover—and try to eliminate, often with the use of psychotherapy—the underlying emotional problem. Says Dr. Walter C. Alvarez of the Mayo Clinic: "Commonly, the biggest factor in the production of an ulcer is a psychic one. A hundred times, after a patient has been operated on, I have seen him get a new and terrible ulcer as soon as he ran into a new emotional jam. And a hundred times I have seen a man lose his ulcer symptoms the day he achieved mental peace."



Man-made caves, built centuries ago, are a big mystery to New England cave hunters. Cave in Shutesbury, Mass., (above) makes stonework in a nearby farmhouse look amateurish by comparison. Caves were built without mortar but have lasted centuries.

Who were New England's ancient cave dwellers ?

by Arthur Davenport

IF YOU SHOULD HAPPEN to see an assortment of people, accompanied by dogs, children and cameras, start off through the New England woods where no path exists,

you are probably witnessing a group of cave hunters enjoying their hobby. These amateur archaeologists interest themselves in any unexplained hole in the ground, or unusual rock formation, looking for proof that the Irish visited the Mas-



Norsemen or Irish explorers of the 10th century are suspected to have been the architects of the amazing New England caves. Other speculation is not so romantic: some people claim the caves were built by eccentric American colonials.

sachusetts coast in the 10th century.

The discovery ■ while back of a Norse colony near l'Anse aux Meadows, on the northern tip of Newfoundland, has confirmed the general belief that the Norsemen made numerous voyages to the North American continent about 1000 A.D. The National Geographic expedition led by Dr. Helge Ingstad excavated nine structures in the summer of 1963 which appear to have been built about the beginning of the 11th century.

The records of the old Norse voyages contain the repeated implica-

tion that other white men had preceded them. Since the Irish explored the North Atlantic before the Norse did, and moved ahead of them as the warlike Vikings advanced from island to island, the theory arises that perhaps the Irish did indeed reach New England at an early date. Tales of ■ great voyage to the west were legend by the year 850.

Voyage to 'Vineland'

In 1010 A.D., the Norseman Thorfinn, brother-in-law of the better known Leif Ericson, made a voyage to "Vineland" and "Markland," which were probably parts of this continent. They brought back the report of meeting five white men who lived in holes in the ground, and seemed to have some knowledge of the land beyond.

About 20 years ago, some stonework was unearthed at North Salem, New Hampshire, which bore a strange resemblance to the Bronze Age stonework at Stonehenge, England. Unfortunately prior damage to the site made scientific investigation of the intriguing work extremely difficult.

Some local people contended that the structure was the work of an eccentric colonial named Pattee, while others suggested it might be Norse or earlier. Geoffrey Ashe, the British archaeologist, added to the mystery by expressing the opinion

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that the stonework predated Pattee's lifetime, but that, even though it was old, it did not appear to be either Indian, Norse or Irish.

The site, now called Mystery Hill Caves, is open to the public during the summer months, and guided tours and explanatory pamphlets are available.

The North Salem discovery aroused the interest of a group of people in Massachusetts who have since made a hobby of investigating any unusual stone formation which they can find. They follow up every clue or rumor and in the past few years have located some most unusual and obviously old caves in Pelham, Wendell, Shutesbury and Leyden, Massachusetts—small towns in the general vicinity of Amherst and Greenfield.

The caves are of two basic designs. The less common variety is a box-like structure, built above ground, usually on a mountain top. It is built of huge slabs of rock weighing several tons each, which are not indigenous to the immediate neighborhood.

The "beehive" type is the one which really fires the imagination. The cave is below ground, usually built into the side of a hill. The opening is about head-high above the earth floor of the cave. The interior is made of rounded stones, very neatly fitted together without mortar. A stone lintel is over the small opening and the cave is topped by a heavy capstone.

Were these stone huts the summer abode of monks who, it is con-

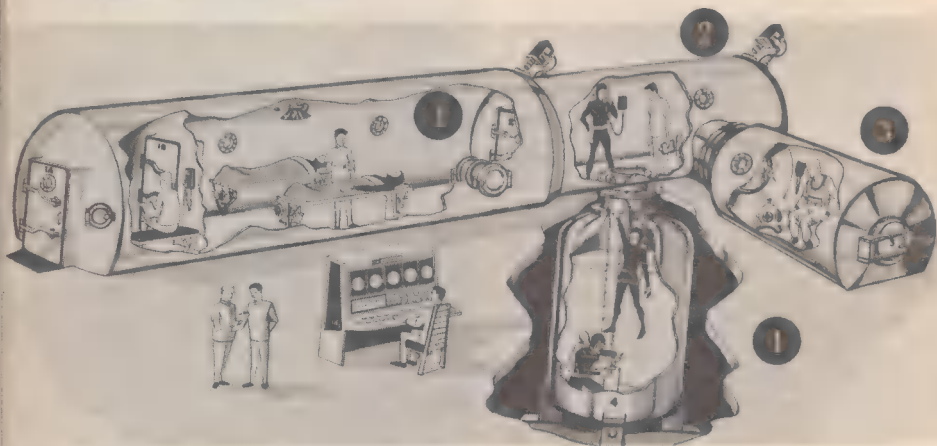
jectured, may have had their base monastery at North Salem?

There is no answer at present, which adds to the fun for the growing band of cave hunters and makes the conjectures of the casual spectator fun for him, too. Most of the caves are difficult to find without help, but many willing guides are available. The Massachusetts cave hunters, whose unofficial leader is an enthusiast named Lionel Girard, of Montague, are delighted to lead the way to their new discoveries. Mindful of inept excavations made at other places, the Massachusetts group leaves the various sites untouched. It is their hope that in time these caves can be scientifically investigated and that artifacts will be uncovered which will help to solve the mystery.

"Beehive" type of ancient cave is shown below. Heavy capstone rests on top of dome-like structure built of rounded stones without mortar into side of a hill. Lintel supports small opening which is head-high above earth floor of the cave.



Science Month



World of inner and outer space

SCIENTISTS at the University of Pennsylvania are planning trips to heights of 150,000 feet (28 miles) above the earth, and to depths of 1,700 or more feet below the sea.

Actually, the far-out explorers won't be going anywhere. Their cruise equipment consists of a 95-ton complex of stationary steel chambers planted at one end of the university's medical laboratories. It is, in fact, one of the biggest, most versatile environmental labs ever constructed—a gigantic make-believe world of inner and outer space. When operative late this year, the chambers will be able to transport men and experimental animals to

the precisely simulated environments found at the edge of space and on the vast, gloomy abyssal plains of the deep sea. In a special compartment of the main cylinder—a 43-foot-long, 50-ton affair comprising chambers No. 1 and No. 2—a hyperbaric room stands ready with an atmosphere of high pressure oxygen to accommodate human patients, and experimental animals, in studies relating to this promising new medical tool.

High altitude work will be carried on in chamber No. 1, the largest. Deep sea experiments in watery environment will be conducted in chamber No. 4, a 25-ton

bell-type vessel 17 feet high and eight feet in diameter, buried underground beneath chamber No. 2 (where high pressures commonly found in deep submersible craft will be simulated).

In order to stand pressures of 735 pounds per square inch, chambers No. 2 and No. 4 are built of steel 2½ inches thick. Chamber No. 3, forming an "L" link with the main cylinder, will be used for environmental experiments with laboratory animals. The chamber is 16 feet long, six feet in diameter and weighs 15 tons.

The complex will be operated under the direction of Dr. Christian Lambertsen, professor of pharmacology at the university.

Since the gigantic affair was fabricated in Chicago, getting it to its site posed some nifty logistic problems. The twin chambers of the main 43-foot cylinder rode a special flatbed truck from the railroad yards to the university—backing and filling through city streets. At

the university, giant cranes transferred the monster from truck to greased skids, and the entire unit was slid gently through a tunnel cut through the Medical Laboratories Building to the courtyard site. Smaller chambers went in the same way and were joined to the main cylinder on prepared foundations. Presently, the assembly is being enclosed and surrounded by a network of laboratories, offices, animal quarters, storage rooms, operating and safety equipment.

According to Dr. Lambertson, the new laboratory will have the greatest pressure capability of human experimentation in the world, extending to far greater depths the research that has made deep diving possible. The unique chambers will also permit dramatic expansion of exploration into problems of aerospace medicine, medical uses of high pressure oxygen, the effects of extreme altitudes and temperatures on biological systems, and the toxic effects of pollution.

78 chromosomes=one dog

The domestic dog differs widely in shape, size, color and behavior, but chromosome count of the species remains remarkably stable all over the world: 78.

Recently, three researchers from the Johns Hopkins School of Medicine studied four breeds of dogs—the beagle, the Shetland sheep dog, the basenji and the Malayan tele-

mian—and came up with the same conclusion. In 86 percent of the blood cells checked, the chromosome count was 78. The counts on all cells varied only from 74 to 80.

The Johns Hopkins team thinks, however, that more chromosomal anomalies may crop up in breeds with physical traits that deviate sharply from normal. The bulldog, with its flattened muzzle, and the sealyham, with its short legs, seem



Mobile dental vans developed by the Navy are making it possible for Seabees in Vietnam to get their teeth taken care of in the same luxury they're used to at home. The 33 by 9-foot trailers have air conditioning, music and two complete dental operator units.

to be good candidates for such anomalies, they suggest in the *Journal of Heredity*.

If chromosomes do not account for differences in breeds of dogs, what does? According to the present evidence, morphological and behavioral variations appear to be controlled by genes rather than chromosomes. Such variations being relatively unstable, they are frequently changed either by nature or by artificial breeding.

New irritant in smog

A previously undiscovered eye irritant in smog has been revealed by General Motors Research Laboratories. The compound is peroxybenzoyl nitrate, and it is 200 times as potent as formaldehyde, a well-known eye irritant. In the specially-constructed laboratories, only 0.02 parts per million of peroxyben-

zoyl nitrate produce moderate to severe eye irritation. Peroxybenzoyl is associated with benzylic hydrocarbons, the most common aromatic in gasoline and auto exhaust.

You dance to words!

Humans often perform an intricate "dance" as they talk, says Dr. W. S. Condon of Western Psychiatric Institute and Clinic in Pennsylvania. An exhibit on the subject was set up recently at the American Medical Association Convention in San Francisco.

By looking at sound films of human behavior, Dr. Condon and his colleagues observed that as a person talks, his body moves in harmony with his speech. His listener "dances," too, in a shared harmony.

This "dancing" has many variations, the investigators point out. Men and women, for example, per-

form intricate movements that send messages of interest to each other.

In one sound film studied, a young male doctor and an attractive female patient perform a "counting dance." The doctor sits, moves his chair and leans toward the patient. In the same frame, the patient leans toward the doctor.

The pair continues coming forward until their heads are about two feet apart. Then, simultaneously, they move their heads upward—a movement sustained for three frames. After this, they move their heads backward, again starting at the same frame.

"There is an absence of sound during most of this sequence, suggesting that this heightened 'dance' may be related to vision," says Dr. Condon.

In addition to romantic signals, men seem to send kinetic messages to one another involving status, dominance and submission, the investigators say.

Radios disturb dreams

Do you fall asleep to the sound of your favorite disc jockey?

If you do, you may be cheating yourself of the deep sleep you need, reports the National Research Council of Canada. The noise level of a quiet radio—about 50 decibels—can disturb a sleeper without actually awakening him. He shifts from a deep sleep into a shallow sleep, probably disrupting his dreams.

Dreams take up about one-third of the normal sleeping time and are considered essential to mental health. Persons deprived of dreams become nervous and irritable. Personalities begin to change within as short a period as 10 days.

The Canadian group bases its preliminary findings on condensed recordings of brain waves. An electroencephalograph (EEG) records eight hours of a sleeping subject's brain waves. These signals are transferred to magnetic tape which is played back at 50 to 100 times the recording speed. A sound-level recorder retains the gross features

Antenna arrays that grow to 1500 feet as shown above (compared to the 1472-foot Empire State Building) belong to NASA'S Radio Astronomy Satellite, which at 450 foot lengths will be able to resolve the location of radio sources for the craft.



of the speeded-up tape.

Features retained include depth of sleep and continuity of time. Scanning this abridged version of a night's sleep, a researcher can pick out meaningful data in less than 10 minutes.

Digital fossil filing

Some offices get a little behind in their filing, but the Smithsonian Institution is some 25 years behind in filing data on its immense collections. To close the filing gap, it recently installed a Honeywell computer to catalog the fossils, flowers, fish and other specimens that make up the 50 million items housed at the institution. New specimens are added at the rate of about one million a year. When all the specimens are computerized, a scientist will be able to retrieve information on the insects of Colorado, for example, in a fraction of the time it now takes.

Cultivated catfish

That succulent catfish at your favorite seafood restaurant is most probably a product of one of the country's newest multimillion dollar a year industries: catfish farming. In the last few years, the growing industry has produced millions of pounds of catfish meat a year, most of it for restaurants. Some of the fish go to lakes where you can pull out the whiskery creatures yourself for a fee. Catfish farms are operated

in the Mississippi River drainage area and in other Central and Southern States.

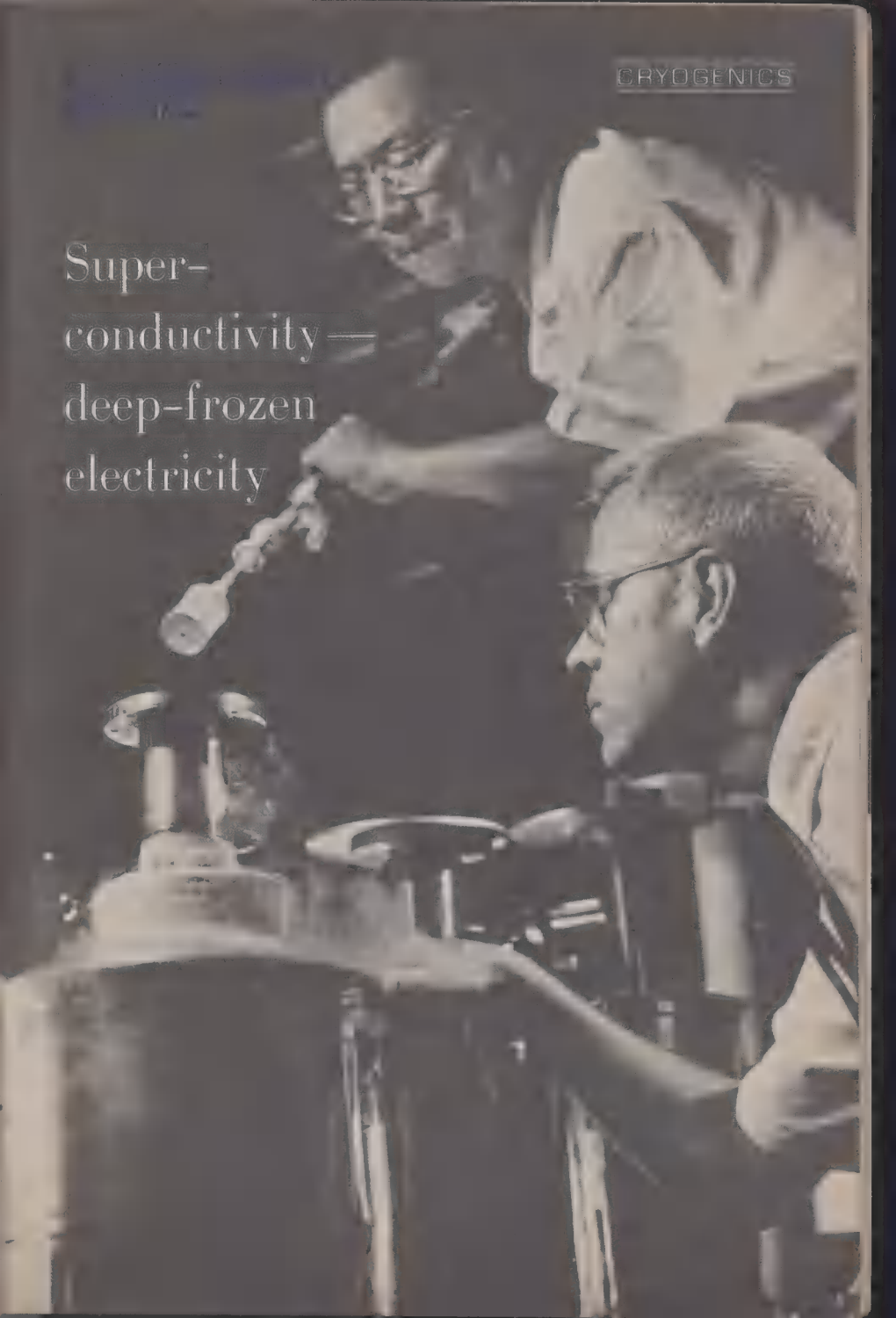
London is for birds again

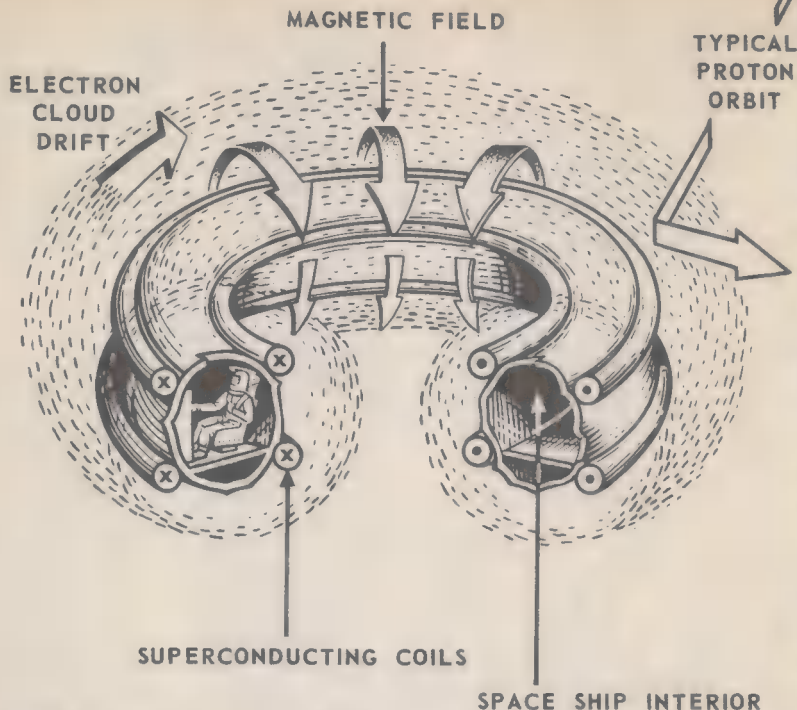
House martins, which haven't nested in London in 80 years, are once again making their nests in the city, observers note. The reason for their return is a lessening of air pollution in Britain's capital, once the most polluted major city in the world. Other insectivorous birds are also returning to London. The insectivores are the first birds to leave polluted environments because pollution cuts insect populations. London passed a Clean Air Act in 1956.

Light up; cool off

The "cool" smoke advertised by some cigarette manufacturers seems to be a reality, although not quite in the way the manufacturers mean it. In thermographic studies made on healthy volunteers by four Philadelphia physicians, it was found that temperatures in toes, fingers and forearms dropped soon after smoking. The results were noticeable as little as two minutes after smoking, but the most intense cooling took place about 45 minutes later. It took 90 minutes for the extremities to warm up again. The explanation for the cooling effect, suggests one of the doctors, is the powerful constrictive effect of nicotine on the peripheral blood vessels.

Super-
conductivity —
deep-frozen
electricity





Spacecraft protection by means of a Plasma Radiation Shield is possible with use of superconducting coil to generate a magnetic field. High voltage spacecraft is safe from solar protons because of hovering electron cloud which slows down protons from the sun as they reach regions of higher potential within the cloud and are repelled.

by Arthur S. Freese

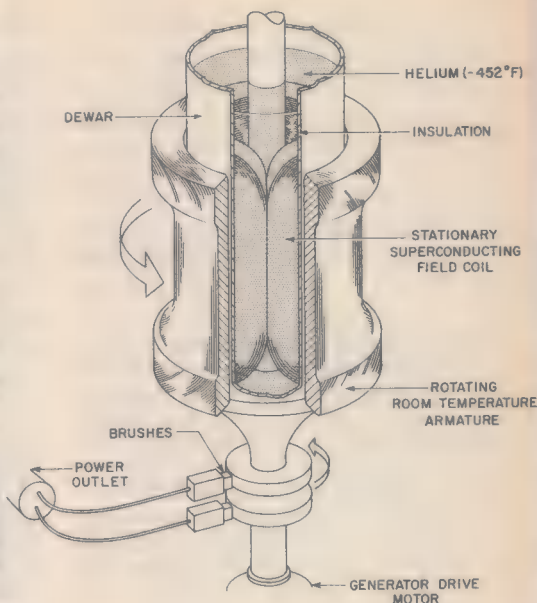
SUPERCONDUCTIVITY, practically a laboratory curiosity only a few years ago (just in 1961), now spells "future" to all of us. Occurring only at nearly 460° below zero F., this strange quirk of nature is the closest thing to perpetual motion yet discovered. It will provide the energy for tomorrow, and its power will soon permit men to travel beyond the stars. As our information explosion continues, we will depend more and more on this strange phenomenon to make it possible to

handle, store and utilize this vast, growing store of knowledge.

Bubble chambers, linear accelerators and data processing—all have benefited. Superconductivity has already revolutionized the field of powerful magnets, its science and technology; it can even take the place of many conventional chemical analyses. The Army looks to it for communication circuits and energy-storing devices; the Navy for ship propulsion and better submarine detection; NASA to protect our astronauts against cosmic rays during months-long flights in space; in-



Superconducting magnet is precooled in liquid nitrogen before being immersed in liquid helium at a temperature of nearly absolute zero. Westinghouse laboratories.



Superconducting generator generates AC current by rotating room-temperature armature through magnetic field of superconducting coil maintained at -452°F .

dustry for more efficient and economical ways to provide the increased electrical energy demanded by today's power-hungry technologies and home appliances. And it promises much more—frictionless motors and high speed trains which don't touch the ground; improved microscopes that already enlarge some ten million times, and shoe-box-size computers; a three-inch diameter cable able to supply all of New York City's electrical needs.

It all started in 1908 when, at the University of Leiden in Holland, a physicist by the name of Heike

Kamerlingh Onnes discovered that if he lowered the temperature of helium below a seemingly impossible 452° below zero F., (about 4.2°K) the gas turned liquid. At these temperatures, scientists like to use the Kelvin scale instead of Fahrenheit: absolute zero, 0°K , is equivalent to -273.15°C or approximately -460°F .

Three years later, Onnes put a ring of mercury in this liquid helium, then induced an electric current in the metal—he was shaken at the result, and the world will never be the same again! For that current

went round and round without ever stopping or decreasing just so long as he kept the metal doughnut cold enough with his liquid helium. He called the state of the metal "superconductive" and termed the metal itself a "superconductor."

When the Dutch physicist got his helium down to 2.4°K (some 455°

below zero F.), something else happened: the liquid now became a superfluid! It ran uphill, flowing up the sides of its container and down the outside. It even found its way through holes so small the gaseous helium couldn't get out—and this gas can find openings so minute that it would take 3,000 years for one quart to escape. In a superconductor at the atom-numbing temperature of liquid helium, electrons or electrical current can move without resistance; just like superfluid helium can move through the tiniest holes, impenetrable to other liquids.

At its "critical temperature," the electrical resistance of a superconductor suddenly disappears and electrons can move through the ma-

Magnetic field of 100,000-gauss is achieved by superconducting magnet. Three separate coils of superconducting wire fit together to form magnet, one of the four strongest in the world. Can be powered by an ordinary automobile battery, which is later disconnected once superconducting currents flow in the magnet coils. Below right: superconductive memory plane will be able to store more information bits per square inch than any conventional computer grid.



terial without resistance. This change from the normal to the superconducting state takes place abruptly within a temperature change of less than 0.001°C . The exact mechanism of this change is still being investigated. When electric current passes through ordinary electric wire or cables (even the better conductors such as copper or silver, *the best*), energy is needed to overcome the material's resistance and is lost as heat. If current is applied to a ring of material in its ordinary state and then stopped, the electrical energy is quickly dissipated. But if this same current is started in a ring of superconducting material, you can remove the source and yet the current will go on and

on indefinitely—it's been seen to do so for years—just so long as the necessary low temperatures are maintained.

Dr. Clifford K. Jones, manager of the Cryophysics Laboratory at Westinghouse Electric Corporation, and an expert in this field, offers some additional facts. This reduction in resistance can be of the order of 10-16—that is, the material would have somewhere around a ten-quadrillionth of the resistance of the material in the normal state. A group of physicists at Princeton University have found that current would go on in a superconductor for more than 300,000 years, and they wouldn't even try to guess at how much longer. In any case, after the first 300,000 years, less than one-half of the original electrical current *might* have dissipated; and this is a generous estimate of the loss which probably would have been much less.

Superconductivity exists in over 1,400 metallic elements, alloys and even a few semiconductors, given the proper temperature, current and magnetic field. These materials range all the way from the original mercury and lead to today's esoteric compounds such as niobium and tin or zirconium, and numerous others. Many more are being discovered all the time. Scientists at the Bell Telephone Laboratories have also been very active in this field and recently found that the superconductive state can even exist as high as about 20°K , a mere 430° or so below zero F. Higher working



temperatures—possibly that of liquid hydrogen or nitrogen and, hopefully, even liquid air—would mean simpler handling and lower costs, making possible exploration of this new field to produce everyday uses for all of us.

The most common and widespread application of this latest scientific magic is in the field of magnetic technology. Superconducting magnets are producing magnetic fields never before practically attainable, and with virtually no power consumption. The higher current density allows a compactness which makes possible the production of magnets of complex shapes—for example, the “baseball magnet” whose windings follow the path of the seams on a baseball. Study of magnetism is pushing far beyond present frontiers into the newer world of the future.

‘Gauss’ magnetic fields

Magnetic fields are commonly measured in terms of “gauss”: the strength of the earth’s own magnetic field varies from about a half gauss at the equator to roughly a full gauss at the poles; a child’s toy horseshoe magnet has a field of approximately 100 gauss. A large conventional electromagnet may develop 30,000 gauss.

Right now, the scientific and industrial worlds are in the midst of a “gauss race”—a drive to build bigger and stronger magnets. At Los Alamos, N.M., and in Europe, scientists anxiously and gently wire

tens of pounds of high explosives together, then carefully back off to a safe shelter. They set off the charges in a world of flame, noise and smoke, and are gleeful when everything is blasted to bits. In New Mexico, for almost a hundred-thousandth of a second, the explosion produces a magnetic field of millions of gauss.

At the Massachusetts Institute of Technology’s National Magnet Laboratory is a conventional electrical magnet which can produce a field of 250,000 gauss, but it requires 16 million watts of electricity (about the power requirements of a town of 15,000) and many thousands of gallons of water per minute for cooling. Dr. C. B. Satterthwaite, a professor of physics at the University of Illinois, says superconducting magnets can be made to produce up to a half-million gauss—all with only a small initial shot of electricity and a steady supply of liquid helium.

When Onnes first discovered superconductivity, he promptly thought of superconducting magnets; but he soon learned that the metals he was using, such as mercury, lead and tin, would “go normal” (lose their superconductivity) when the magnetic field increased beyond a practically useless weak field. These metals are now known as Type I superconductors. It was another 50 years, in 1961, before scientists at Bell Laboratories discovered the Type II superconductors which started the present magnet explosion: these consist of com-



Superfluidity and superconductivity are related and explainable by the quantum mechanics concepts that matter has properties of waves as well as particles. P.W. Anderson and P. L. Richards of Bell Telephone Labs, Murray Hill, N.J., proved theory in experiments with superfluid liquid helium: atoms of the substance behave like coherent waves.

pounds such as niobium-tin and niobium-zirconium, which retain their superconductivity even at high magnetic fields.

One of the first of these was developed by Westinghouse—no larger than a doughnut and weighing only a pound, its field of 43,000 gauss was started by an auto battery. A conventional electromagnet of similar strength would have weighed an estimated 20 tons and required its own power plant to continuously supply some 100,000 watts of electricity.

Dr. Jones startled me when, in his calm British accent, he coolly commented: "When we go in for thermonuclear power generation, as it seems inevitable we must, the 'magnetic bottle' which is used to contain the thermonuclear reaction will undoubtedly be generated by superconducting magnet systems." He explained that "this is the largest power source we've got—the hydrogen in the ocean. . . ." Those concerned with this problem are thinking in terms of supermagnets 40 feet long and ten feet wide in

cross-section, with fields so powerful that conventional magnets would be impractical. Dr. Jones concluded: "Superconducting magnets are the way into the energy source of the future!"

Our future astronauts, traveling far beyond the stars on months-long space voyages, will likely depend on these super-magnets to provide their power. One way would be by containing a thermonuclear reaction, another by providing a magnetic en-

ergy-storage device whose stored power can be converted into electricity rapidly and efficiently. These explorers will be protected from the high-energy particles of solar flares by a magnetic field, and one suggestion has been for a doughnut-shaped spaceship. The necessary supermagnets would weigh only one-twentieth the conventional protective armor plating.

These same supermagnets are important in high-energy physics, the

SOME SUPERCONDUCTING MATERIALS AND THEIR CRITICAL TEMPERATURES

Element	Critical Temperature °K	Compound	Critical Temperature °K
Mercury	4.16	Niobium-Aluminum-	
Lead	7.2	Germanium	20.1
Tin	3.72		
Technetium	11.2	Niobium carbide— niobium nitride	17.8
Niobium	8.70		
Lanthanum	5.4	Niobium stannide	18.1
Vanadium	4.89		
Tantalum	4.38	Graphite compounds vary from	0.020 to 0.55
Thallium	2.39		
Thorium	1.37		
Aluminum	1.20		
Gallium	1.10		
Uranium	1.0		
Zinc	0.91		
Cadmium	0.56		
Osmium	0.71		
Zirconium	0.55		
Titanium	0.39		

°K can be converted to centigrade by subtracting 273.15°

Critical temperature is that temperature at which the material becomes superconductive.

exploration of the ultimate structure of matter. They are now used in bubble chambers, the original idea for which is said to have come from a glass of beer with its rising stream of bubbles. Linear accelerators, in this same area of research, are used for generating particles rather than studying them as in the bubble chambers. Dr. Jones told me of a superconducting linear accelerator at Stanford University which is an exceedingly compact device for producing high-energy X rays and may end up as an industrial tool.

A frictionless superconductive gyroscope is being investigated by NASA, and supermagnets are being sent up in balloons to study cosmic rays. Electron microscopes can magnify up to some ten million times: their magnetic "lenses" (actually a non-uniform magnetic field) have the same effect on the electrons it uses as the optical lenses of the conventional microscopes have on the light they use. Supermagnets offer further improvements in resolution and enlargement.

The U.S. Department of Transportation is studying the use of supermagnets for high speed trains which will ride in the air: magnetic fields will repel the "track" so that there is no contact as the trains race along. It has been estimated that these trains can reach speeds of 300 miles an hour with travel costs far below that of planes. With no friction, maintenance would be greatly reduced.

Marne A. Dubs of Union Carbide, one of the top experts in super-

conductivity, estimates that "by 1985, energy consumption may be four times that of today. By the year 2000 the energy plant will be seven times that of today." A superconducting transmission line would carry electricity with virtually no loss of power, and Dubs sees the DC superconducting line as simple in construction—a hollow pipe, plasma-plated with a several mil thickness of niobium-tin, could carry 10 million kilowatts of power for as much as 1,000 miles at 150 kv. The whole assembly need only be some eight to ten inches in diameter. So close are we to superconducting transmission that the Edison Electrical Institute has given two contracts to Union Carbide for studies of underground cable systems for AC power transmission. Some even say that all the electrical needs of New York City could be supplied by one superconducting cable just three inches in diameter.

Superconducting magnets

As the requirements of our data information handling systems increase, there will be more and more applications for superconductivity in this area. In fact, Dr. Jones says that superconducting magnets may be the only solution as ever larger systems become increasingly necessary. Dr. Alfred Leitner, professor of physics at Michigan State University, points out that two of the most important applications of this phenomenon are the superconducting switch and the cryotron (the

third is the superconconducting magnet).

The cryotron is essentially a superconducting switch used as a computer element. Cryotrons can take over many functions of the vacuum tubes and transistors. These new devices can be combined to make some one million memory areas in a space 2x2x8 inches. Thus a new generation of computers may be in the offing—faster, smaller and more efficient than the best we have today. Some scientists even talk of shoe-box-size computers!

Magnets in medicine

Another possible area for superconducting magnets is in medicine, where powerful conventional magnets are now being used to move drugs around in patients' stomachs to get better X rays or to move tiny magnets pulling plastic tubes behind them through the blood vessels of animals' brains to carry drugs to the exact spot to be treated. Even kinks in children's intestines have been straightened out by putting in magnetic filings, then quickly moving powerful magnets outside the skin to move the intestinal tissues accordingly.

Supermagnets have also been used to build generators capable of producing 8,000 watts of AC electrical power for the U.S. Army Engineer Research and Development Laboratories which have been reported as suggesting its use in military transport vehicles, radar, communications and advanced weapons sys-

tems. This generator may one day power public transportation vehicles, hospitals, farms and other situations which have use for such mobile, lightweight and compact power.

The Army is also interested in energy storage devices such that large current can be introduced into a coil of superconducting wire so it would be available for tapping at any time. The Navy, too, is looking to superconductivity for help—for rotating machinery for ship propulsion, cryogenic computers and servomechanisms. Navy spokesmen are said to have mentioned radio oscillators with ultrasharp tuning and the ability to squeeze more communications channels into a given waveband; even magnetometers for better detection of submarines.

Fantasy into fact

Among other applications of superconductors are such things as DC voltmeters sensitive to a quadrillionth of a volt; infrared detectors with a response time better than one hundred-millionth of a second; an ultrasensitive gravimeter to sense earth tides.

Probably the best commentary on the present stage of this new world of superconductivity is that of Dr. Satterthwaite: "It is probable that the wildest speculations we can make now about the possible uses of superconductivity will seem to have been quite modest at the end of the next decade or two."

Significance of these new developments to industry, business and professions

- *Aerospace* — Superconducting magnets will provide a variety of power plants capable of driving space vehicles on months-long voyages beyond the solar system.
- *Agriculture* — Lightweight and compact superconducting generators will supply electrical power to areas where power lines do not reach and act as an emergency backup.
- *Data-processing* — Our information explosion is rapidly overwhelming present-day computers. Superconductivity will redress the balance. New superconductive devices can put some million memory areas into a space of 2x2x8 inches.
- *Electronics* — Superconductivity can be used to give radio oscillators the ability to squeeze more communications channels into a given waveband; cryotrons will take the place of vacuum tubes and transistors.
- *Medicine* — Magnets can be used to move plastic tubes with medication around in the brain and pinpoint X ray pictures.
- *Metal fabricators* — Superconductive-produced compact high-energy X ray machines can be used to check for defects in metal for autos, pipe lines and other essential metal parts.
- *Military* — Superconductivity will lend itself to submarine detection and ship propulsion machinery; for radar, energy storage devices and advanced weapons systems.
- *Optics* — Electron microscopes now capable of 10 million time enlargements will be improved by superconducting magnets (magnets act as the "lenses" of these microscopes).
- *Research and development* — Supermagnets are smaller, more powerful and much cheaper to operate, thus increasing their value and availability. They are of increasing importance in high-energy physics, in bubble chambers and linear accelerators.
- *Transportation* — Supermagnets will make possible frictionless high-speed trains which will run suspended in mid-air, never touching the ground, yet reaching speeds of up to 300 miles per hour—and at travel costs far below that of planes.
- *Utilities* — By 1985 we will need four times the energy we use today, and by the year 2000 —seven times. Only the use of superconductivity will make it possible to cope with this.

NEW FOR INDUSTRY

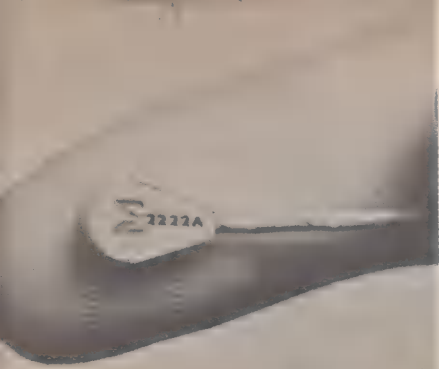


Radar antenna of the future (above) is the receiving array for prototype of a new phased-array radar system. Protruding rods are energy feeds that will extend from each hole. Advanced Design Array Radar (ADAR) is by Hughes Aircraft, Fullerton, Calif.

Visual characters are converted from spoken words by method developed by IBM Systems, Kingston, N.Y. Alphabetic generator uses tube with inner phosphor coating upon which electron beam writes.

Chemically strengthened glass case, developed by Corning Glass Works, Corning, N.Y., for use in extreme ocean depths, has been made for future use on a larger scale as a man-carrying deep-submersible.

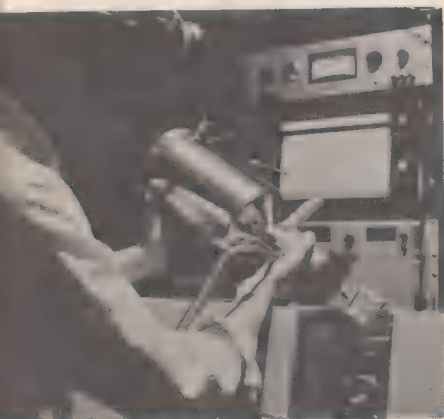




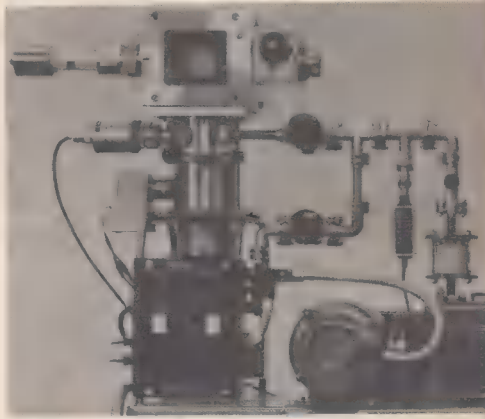
Miniaturized accelerometer (above) performs shock and vibration measurements on specimens previously inaccessible to such instruments. Designed by Endevco Corp., 801 S. Arroyo, Pasadena, Calif.



"Electronic eyeball" (above) on tip of tweezers will improve laser communications. Picks up single channel off laser beam that carries all VHF and UHF TV channels. Texas Instruments, Dallas, Texas.



Infrared spectroscopy (above) can now be used to determine the composition of complex gas mixtures with possible applications in special air pollution control. By Bell Telephone Labs, Murray Hill, N.J.



Proton-scattering microscope enables scientists to study crystal structures by means of shadow pictures on fluorescent screen. Will locate impurity atom sites. Edwards High Vacuum, Sussex, England.

Giant high-pressure chamber, for testing and evaluating materials in a simulated deep ocean environment, consists of heavy steel rings with sheet steel liner. Takes 20,000 psi—4,000 more than deepest known ocean depth. IIT Research Institute, Chicago.



To drink or drive ?

by Arthur J. Snider

THE OLD RULE, "If you drink, don't drive—If you drive, don't drink," is still best; but for those who find they must on occasion mix these two activities, Dr. Julian A. Waller, a Berkeley, Calif., physician, offers this guide:

"No matter how well one thinks he can hold his liquor, he should not have more than one drink (a single 1½ ounce jigger) per hour. He should dilute it with water, soda or other non-alcoholic liquid and should have food with his drink."

Hosts and hostesses may not be aware of the extent to which food can reduce blood alcohol concentra-



tion, Dr. Waller points out. Serving food before drinks can reduce concentration by as much as a half and the serving of food with drinks, by one-fourth to one-half.

The rule of thumb does not apply to certain special groups for whom even one drink may reduce safety, either as drivers or pedestrians, cau-

tions Dr. Waller, who is a medical officer of the California State Department of Public Health.

"One of the most dangerous of combinations as far as highway safety is concerned is the combination of inexperience in driving and inexperience in drinking," Dr. Waller adds. "While many adults can get away with drinking one or two before driving, the teen-age and young adult driver cannot. No person with less than two years driving experience or who has been drinking hard liquor for less than two years should under any circumstances consider driving after drinking."

Although he offers some flexibility for many drivers, Dr. Waller emphasizes he is not suggesting a philosophy of, "If I can get away with one or two, maybe I can get away with three." He points out that most persons are adversely affected by alcohol long before they appear intoxicated. The person who looks as if he had only "a couple" often has had 5 to 10 drinks and is extremely dangerous as a driver or a pedestrian.

Records show about half of all drivers and adult pedestrians fatally injured in highway crashes have been drinking. Among those responsible for initiating crashes, the proportion is even higher.

In most crashes, the drinking driver or pedestrian has a blood alcohol concentration of 100 milligrams percent (0.10 percent by

weight) or higher. This concentration is equal to or greater than the amount of sugar normally present in the blood. In order to reach this concentration, a 150-pound person, drinking between one and two hours after an average meal, would have to drink 7½ ounces of 80 percent proof liquor in one hour. This equals five standard 1½-ounce jig-

gers of gin, bourbon, scotch or vodka in one hour.

Although many drivers occasionally drive shortly after drinking, studies show that most, if not all, persons in crashes after drinking have previous histories and current patterns that indicate they are problem drinkers rather than social drinkers.

Cheery side of fatness

A physician who carries 215 pounds on a six-foot frame calls for a halt to the "cult of emaciation." He says it has created a "false image of beauty" as well as guilt feelings on the part of those who cannot fit the wispy mold.

"We have come to assume that the stature of a full figure and the pleasurable consumption of good food in quantity is sinful," declares Dr. Thaddeus Kostrabla of Northwestern University.

"Mothers now fret if their babies are too fat. Pets are reduced (and the poor brutes don't know why) and young girls have come to believe that a gaunt, emaciated weak and spindly pose will attract the eligible males."

He lays the blame for the thinking-thin craze at the door of life insurance companies and doctors who practice internal medicine, particularly those who specialize in weight-reduction.

Despite "threats and cajolery," most patients continue to behave

with "good sense," he adds and to eat well and flourish "both spiritually and physically."

The ample endowment of corpulent men and women reflects "an intellect and soul," he continues, and their inner life "unfolds itself in a flowering of social action and love."

"We have many examples of this in Buddha, Winston Churchill, Grover Cleveland, Santa Claus and Peter Ustinov."

Premature aging

Atomic bomb survivors in Hiroshima and Nagasaki are showing premature aging of the skin in the form of wrinkling. Dr. Marie-Louis T. Johnson also has found earlier graying of the hair.

"This is the first evidence in human experience of accelerated aging following exposure to ionizing radiation," she says.

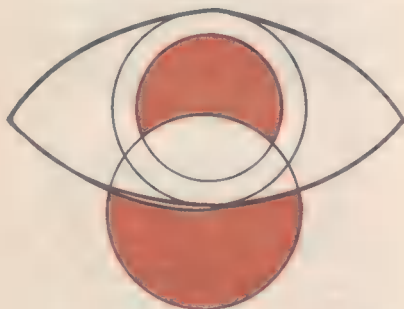
Knowledge of the harmful effects of radiation has caused radiologists to cut down on the use of X-ray

treatment for benign conditions, Dr. Johnson says. It is now used almost exclusively for the treatment of cancer.

"There is some suggestion that the decline of leukemia among children in the United States in the past 10 years is due to greater awareness of the potential dangers of ionizing radiation," says Dr. Johnson.

The 'stick-on' eye lens

A tiny plastic contact lens glued to the corneal surface of the eye can restore sight to persons blinded by certain diseases of the cornea. Dr. Herbert E. Kaufman of the University of Florida, Gainesville, reports five persons have been so treated. The process takes only 10



minutes and requires no hospitalization. The diseased or damaged outer covering of the cornea is removed and a protective layer of plastic is bonded to the cornea, using small amounts of a tissue-adhering plastic glue.

Among diseases for which the plastic contact lens has been used

are corneal dystrophy, a degeneration occurring with age, and blindness associated with blistering of the corneal surface. Vision inadequate for reading small print can be improved to a level permitting the patient to be fully active. Pain is also relieved.

Dr. Kaufman emphasizes that the technique is still experimental; there is no certainty how long the lens will stay in place. It is believed, however, that even if the glue should wear away, the lens may be held in place by epithelial tissue growing over the edges of the lens, like a collar.

If experience shows the lenses can be easily tolerated, they could be used to treat more common visual troubles such as near-sightedness that glasses cannot adequately correct, and optical distortion created by the removal of a cataract from the eye.

Patient's blood re-used

A process by which a patient's blood lost during surgery is collected, processed and continuously returned to the circulation of the patient has been developed at the Mayo Clinic, Rochester. Blood from the surgical suction-aspirator or a blood-saline mixture obtained from washing out the surgical field or from the sponges is fed into a centrifuge in which the cell elements of the blood are extracted from the waste fluid. This method provides a means of removing contaminants

from the blood and also gives an accurate determination of blood loss at any stage of the operation.

Doctors believe a small, automatic, low-priced unit can be designed for use in the operating room. The method will provide a ready source of fresh compatible blood which will be especially valuable in smaller hospitals where banked blood may be in short supply.

Transfusion by this method can be started immediately in emergency patients, well before banked blood can be typed or crossmatched. Autotransfused blood may have a greater protective effect in a patient in shock, compared with cold, banked blood.

The technique also avoids the hazards associated with banked blood. There is considerable expense involved in staffing a blood bank, in recruiting donors and in processing, grouping, typing, crossmatching, storing blood.

If a safe and practical method of autotransfusion can be developed, it may prove superior to the use of banked blood in operations, Mayo surgeons believe.

Fast hernia surgery

Patients who have undergone groin hernia surgery are walking through hospital corridors and even driving home the same day, Dr. Irving L. Leichtenstein of Los Angeles reports. Many are able to return to their regular jobs the next day instead of remaining in the hos-

pital from four to seven days and then following a period of restricted activity.

The one-day operation is achieved through a particular anatomical approach. Local anesthesia permits immediate testing of the hernia repair for strength. Skin sutures are removed within 24 hours.

Barnacle glue for cavities

Restoration of decayed teeth requires that the filling be mechanically locked into the teeth. This in-



volves removing not only decayed areas but also sound tooth structure and even a sacrifice of tooth strength in some cases. If a good adhesive filling material were available, it would be necessary only to remove the diseased part of the tooth and place the filling directly, thus conserving tooth structure.

The answer may come from a strange source. The barnacle, as all mariners know, has a remarkable ability to adhere to all surfaces. It

serves as an attachment surface for thousands of species of marine organisms, a process known as fouling. Up to \$700,000,000 a year is spent in defouling commercial and military vessels.

Research is underway at the University of Akron to determine whether the adhesive secreted by the barnacle, or a synthetic form, may provide the long-sought dental material.

Ethics vs sick pilots

A Federal Aviation Administration surgeon believes physicians should place public interest ahead of the confidential doctor-patient relationship by disclosing any disability that would ground the individual as a private pilot. Many physicians, says Dr. Peter V. Siegel, treat pilots who have had a severe psychological episode, a heart attack or some other disqualifying defect.

"While we cannot advise any physician to violate the ethics of his profession," he asserts, "we feel strongly that in these instances the public safety is by far the overriding consideration. A disqualified pilot is a menace to human life, including his own."

The doctor who knows a pilot is concealing information from licensing authorities and continues to fly should promptly report the information to the proper authorities, advises Dr. Siegel.

Unlike the pilot in the military system who has undergone rigid

selection processes and is under constant medical observation, the pilot in civil aviation may be a male or female, 15 to 80 years old, in varying degrees of health, says Dr. Siegel. There are more than 650,000 private pilots and the ranks are swelling by 13 percent a year.

If it's 'pot', don't panic

Parents who suddenly discover their son or daughter is smoking marijuana should not panic, Dr. Arthur Bolter of Castro Valley, Calif., advises. Instead, they should calmly evaluate the situation and determine how deep the involvement has become.

"Most parents visualize the affair as a first step to a life of hard narcotics and crime," Dr. Arthur Bolter adds. "Smoking marijuana does not inevitably lead to narcotic addiction. It is not necessarily related to criminal or uncontrollable sexual acts. However, individuals can become psychologically dependent upon its use."

Dr. Bolter says it is not proper to contend that a person who tries marijuana a couple of times is using the drug in the same manner as one who smokes it daily or several times a week.

"The reasons for drug use and abuse by young people are many and varied," he points out. "Probably the foremost motivation for the average teen-ager is kicks. Another reason is an intolerable situation at home."



Guinea pigs are being exposed to Saturn V rocket firings at NASA'S Marshall Space Flight Center, and Tulane University doctors are studying the animals for signs of hearing loss.

Rocket blasts and guinea pigs

TWO DOZEN guinea pigs at Bay St. Louis, Miss., are getting closer to Saturn V rocket firings than any human personnel at the NASA test facility here. A team of *Tulane University* doctors are placing the rodents in cages at 75, 150 and 300 feet, and one mile, from the firing site to check the effects of low frequency blasts on the ear.

In a preliminary report, the Tu-

lane specialists indicate that some of the guinea pigs have suffered total hearing loss from inner ear damage. Dr. Gerardo Gonzalez, head of the Tulane project, attributes the damage to obstruction of the blood supply to the hair cells of the inner ear.

Another member of the study team, Dr. Clifton Istre, observes that the noises resulting in the most

hearing loss are those at 4,000 cycles per second. This range is not considered particularly critical to speech intelligibility, but it is apparently of importance to the ear.

"But rocket noise is unusual since it is essentially of low frequency," says Dr. Istre. "Very little is known about the aural effects of high intensity, low frequency noise."

After exposure to the blasts, the guinea pigs undergo a preliminary reflex test which gauges their general responses to sound. Then the rodents are shipped to the Tulane

laboratories, where electrodes are implanted in their ears. The electrodes enable technicians to plot audiograms of the animals' responses to sounds.

Information obtained in the Tulane tests isn't expected to be of any practical application for some time, but NASA thinks that the data could play a big role in guarding civilians from ear damage in the 21st century. By that time, they say, it will be common for people to live in the vicinity of rocket launch pads.

Violence affects brain

Mice that see other mice fighting for 75 minutes display aggressive behavior by clawing at their cages, report two brain chemists from the *University of Tennessee's Memorial Research Center and Hospital*. Mice that don't observe the fighting sleep or sit quietly in their cages.

When Dr. Bruce Welch and his wife, Annemarie, dissected the mice that manifested the aggressive tendencies, they found that the rodents showed a diminished level of the chemical norepinephrine in the brain. Norepinephrine acts as a transmitter of nerve messages in the pons and medulla oblongata of the brain, which are responsible for awakening and alerting an animal.

Similar changes in norepinephrine levels are believed to be characteristic of certain mental disorders, including schizophrenia. The Welch

suggest that their findings might help explain how social and psychological pressures could precipitate illness in man.

Solar storms predicted

Radio astronomy work at the *University of Pennsylvania* is clearing up some of the mysteries about solar storms, those violent outbreaks of activity that are observed on the sun's surface from time to time. Eight times in the past three years, a team of astronomers led by Dr. John P. Hagen has detected solar storms from a half minute to a half hour before they occur. Four radiometers to measure radiation are trained on the sun, each radiometer connected by an electronic circuit to a pen that writes out energy measurements on a roll of paper. Before a storm, the astronom-

ers find, the graph line rises into a series of foothills and then into a cliff-shaped mountain. A typical storm starts with a cloud of electrified gas which rises rapidly through the solar atmosphere until it explodes and dissipates.

Antlers fine as radiators

The antlers of stags, long considered a symbol of masculinity, are actually a kind of radiator, claims Dr. B. Stonehouse of the *University of Canterbury* in New Zealand. According to his theory, the stags dissipate excess heat through their growing antlers during the fall mating season. The antlers grow up so they can catch as much air as possible.

Dr. Stonehouse, whose findings are reported in *Science Journal*, devised a radio thermometer for measuring the surface temperature of the stags' antlers under normal wild conditions on New Zealand's South Island. The deer were anaesthetized while a radio transmitter was fitted on their heads and an aerial placed among their antlers.

Thus equipped, the stags' antlers underwent some surprising changes. When the animals were moving around, the temperature of the antlers rose to blood heat, particularly when the deer moved into the sunlight. In the shade, or when the animals sat or slept, the temperature of the antlers dropped markedly.

Dr. Stonehouse doesn't think



U.P.I.

This stag has his own built-in radiator in the form of a respectable set of antlers. According to a professor at the University of Canterbury in New Zealand, excess heat is dissipated through the growing antlers of the stags during the fall mating season.

much of the theory that stags use their antlers for fighting. In the first place, he says, stags seldom really fight. What may look like a fight is usually just a series of threatening gestures. He points out, too, that antlers aren't much of a weapon. They're the wrong shape, they're in the wrong place, they have too many entangling spikes and they use up a lot of energy growing anew each year.

As radiators, though, antlers definitely have their points.



All Photos Pip

The Russian space program on display

by Dr. Charles S. Sheldon II

FOR THE GREATER PART of the decade since Sputnik 1 in 1957, the Soviet Union had carefully shielded from Western eyes the space hardware which brought it a succession of technical and propaganda triumphs, largely reshaping world opinion of Soviet capabilities. Fanciful pictures of winged rockets on Soviet bloc postage stamps tantalized Western observers seeking some clue as to how the Russians put up huge weights in excess of

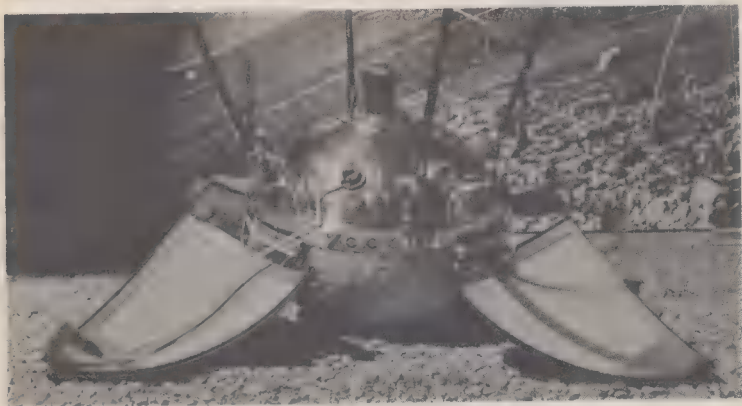
what the United States could do in the same period.

Now the Soviet Union is showing a more relaxed attitude, and they are putting actual spacecraft and rockets on display in selected cities abroad. The hardware, based on the same principles as our own, is impressive enough, and certainly has a greater impact on Western engineers than air brush pictures of un-

Dr. Charles S. Sheldon II is Acting Chief, Science Policy Research Division of the Library of Congress.

Vostok space capsule (left), shown with Soviet Cosmonaut suit, is eight feet in diameter and weighs 5,000 pounds. Notice window and hatch. Bowling ball shaped bottles are part of steering unit which separates from capsule before re-entry. Shown too is rocket which puts payload into orbit, then separates.

Luna 9 mockup (below), first successful soft landing device on the moon, shows open petals, extended antennas and central rotatable mirrors for taking panoramic TV pictures. Weight: 220 pounds. Although only 27 pictures were taken before its batteries wore out, Luna 9 answered many essential questions.



Molniya 1 type satellite uses two high gain antennas like the one below, Umbrella-like dish unfurls in orbit and is powered by three electronic feeds at bottom of picture.



Orbital adjustment or steering in Molniya 1 satellite (below) is controlled by gas pressure bottles appearing like polished metal globes at base of the space craft.





Proton satellite (left) was an early Soviet space giant. It weighed almost 27,000 pounds. Designed to detect cosmic rays and to measure energies up to 100 trillion electron volts. Diameter of 15 feet does not include four protruding solar cell panels, the power plant.

Vostok catapulting sled (below) ejects Soviet pilot at 20,000 feet when explosive charge blows a hatch in the capsule. Pilot is then detached from sled and comes down on personal parachute. Gagarin, first cosmonaut, did not use sled; he rode capsule to surface.

Luna 10 replica (below right) shows the total assemblage which achieved a lunar orbit. Once "braked" into orbit, the capsule—500 pound barrel-like object at the top—separated from its "bus" and carried out its mission of measuring lunar phenomena from orbit.

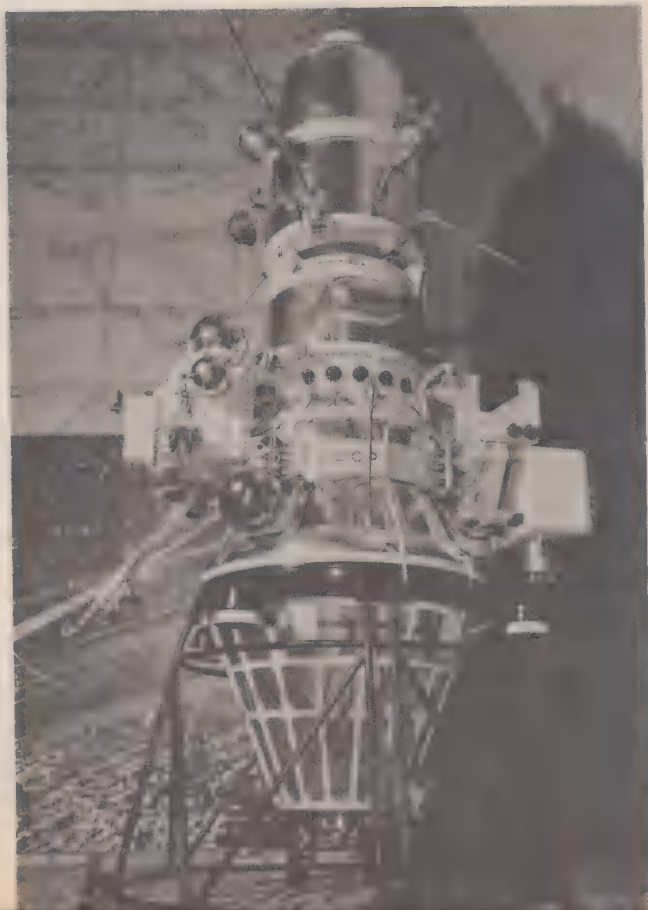
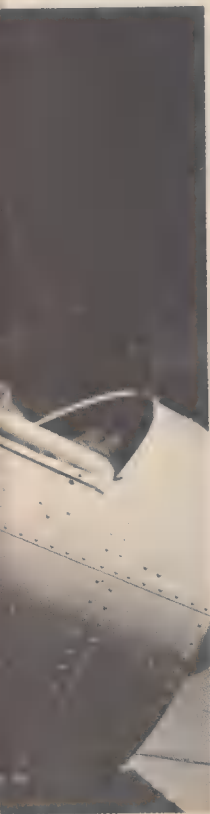


likely designs. Perhaps the Russians are responding to the long-term effort of our National Aeronautics and Space Administration to explain the workings of U.S. equipment, so that world audiences are more sophisticated, and our openness has made Russian secrecy look bad.

While not first time disclosures, the pictures shown here from a display in Rome earlier this year are illustrative of the hardware which has brought an enthusiastic response from viewers not only in Rome, but also at Expo 67 in Montreal, the

Paris Air Show and in smaller shows in Belgrade and Budapest.

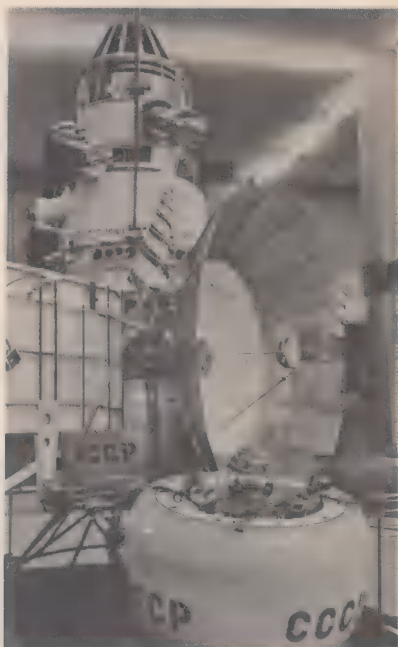
Apparently the Russians started to think on a fairly grand scale about space in the early 1950s, and their large ICBM of 1957 has been the mainstay of their space program from Sputnik 1 until recently. With an initial capacity to put 3,000 pounds in orbit (compared with 4 pounds for the first Vanguard), by adding upper stages they then extended this rocket's capacity to 16,000 pounds in earth orbit, or 3,500 pounds to the moon, or 2,400





Vostok space capsule replica (above) with hatch covers removed to expose interior. Its 8-foot diameter makes cramped quarters.

Venera 4 (right) used in Venus shot. Fore-ground: atmospheric probe. Background: complete replica of spacecraft showing steering section at top, data-measuring device in middle, solar cell panel, middle left and umbrella-shaped antenna, center.



pounds to the near planets. This monster rocket has five clustered tanks for the first stage, and a thrust of over ■ million pounds.

While their thinking has been bold, actual flights have proceeded in an orderly, conservative fashion, particularly where human life is concerned. Despite stories to the contrary, evidence is overwhelming that no lives were lost in orbital flight until Komarov's Soyuz 1 parachute lines tangled after reentry in 1967. Safety has been achieved by multiple test flights before committing men, by use of a weight great enough to permit redundancy in vital subsystems, and where practical, using over and over again the simplest equipment which would work.

Their early start and greater lifting capacity permitted them to win ■ succession of "firsts."

We can note the flight of Layka, the dog, in 1957, while our first ape went into orbit in 1961. They achieved a near co-orbit rendezvous with men in 1962, while ours came in 1965, although ours was more impressive for being sustained. They beat us to manned extravehicular activity by a much narrower margin in 1965, and now we have more experience in that, as well as total manned flight.

The competition of the two countries in lunar and planetary flight also highlights differences and similarities. Both countries planned to achieve unmanned soft landings on

the moon in 1963. The Russians' actual flights started early that year, and failed at least six times before Luna 9, (pictured) in 1966 reached the lunar surface, opened its petals, and before batteries failed, sent back 27 panoramic views of the immediate landing area. Our Surveyor was three years late in making the first flight a few months after Luna 9, but made a more gentle landing on the very first try, and its solar cells permitted the return of over 11,000 pictures. However, the handful of Soviet pictures answered the fundamental questions which our elaborate system then confirmed.

The Soviet planetary program was especially ambitious, starting flyby TV and atmospheric probe attempts to Mars and Venus at every opportunity but one since 1960. Of 19 attempts, only Venera 4 (also pictured) brought back planetary data when it floated in the atmosphere of Venus. Our more modest Mariners, whose combined weight was only a fifteenth that of the Russian series, twice returned indirect data from Venus and fantastic pictures of the surface of Mars.

Our lead in practical applications of space flight—weather reporting, communications, navigation — has been unmistakable. Now the Russians are working hard to catch up in this regard. Their Molniya 1 class comsats, (also pictured) are illustrative. Although not floating as a fixed point over the Equator relative to the surface of the earth as do our Intelsats, Molniya 1 is a first-class solution to Soviet needs.

It swings in an eccentric 12-hour orbit tilted to swoop low for a short time over the southern hemisphere, but loiters high over the Soviet Union for eight or nine hours each day, giving good coverage in the Arctic where our comsats are at a disadvantage. The high power of Molniya 1 permits a large number of relatively simple Soviet ground stations to receive TV, telephone and teletype signals from other parts of the Soviet Union. Now they also have weather and navigation satellites.

The Russians do not put into their traveling exhibits copies of their military satellites. Over 100 observation payloads have been flown in unmanned versions of Vostok. A camera which with its film is recovered replaces the human pilot. Also not displayed abroad, but identified in Moscow parades, have been rockets capable of carrying bombs in orbit. Our Secretary of Defense indicated that FOBS (fractional orbit bombardment satellites) have been test flown, presumably without nuclear warheads on board.

For the near future, we can expect the Russians to move to more powerful rocket systems, capable of carrying men around the moon and of establishing a permanent station in space. Later will come a manned lunar landing and manned flight to the planets. The relative quiet in U.S.-Soviet competition of the last two years will soon be broken. Cooperation may come in time, too, but probably not soon on a large scale.

Biped poodle

A TWO-YEAR-OLD black French poodle in Denmark, started showing a preference for walking on his hind legs when he was about three months old. Since then, he has spent most of his waking moments walking around like people

instead of like dogs.

Osteologists who have examined him believe this is due to an unusual bone formation in the dog's back. Head of the Odense County and City Hospital of Hojvaenget reports that: "Examination of the pelvis and hipjoint shows a somewhat longer column femoris than on other dogs; the sacral cavity seems to be flattened, resulting in better leverage for the muscle action in an upright posture."

The dog is owned by Carl W. Solling of Hojvaenget. Needless to say, he's had many offers to sell his unusual pet. The highest so far was for nearly 500 pounds sterling (\$1,380). But he isn't interested.



BIPS

Even other dogs on the streets of Hojvaenget look puzzled when they see Denmark's biped poodle walking around upright, like people. X ray (left) shows unusual bone formation that makes his stance possible.





Telescope was built by Oceanside, Long Island, high school students. With guidance from science department head Edsel Langdon, students ground their own 12½-inch mirror lens.

Space age career men

A national group of high school students called JETS are programming computers, building telescopes, testing potentials for life on Mars—enroute to engrossing, lucrative careers in tomorrow's world of science and engineering.

by Richard Dempewolff

OUT IN OCEANSIDE, Long Island, two high school upper classmen—Robert Sasson and a classmate—set up a complex computer

program on 11 data cards this year. It was aimed at determining the probability of civil war in the United States last August. Meanwhile, David Seitman, at the same school, was at work developing a



Soniscope designed by high school youth helps the blind "see" by bouncing sound waves off close range objects as in sonar.

formula to determine the energy levels in various semi-conductor materials. "We may come up with a new transistor or diode with better energy levels than those we have now," he says.

A few years ago, a whole group of Oceanside students under the supervision of Edsel Langdon, then head of the school's science department, ground a 12½-inch mirror lens and built a telescope. It's installed in an observatory in a public park, where any astronomy buff can use it.

And at Sacred Heart High in Springfield, Mass., Ed Gagliardi, a junior, recently created a closely controlled Martian environment in a bottle, and proved that certain life forms could, indeed, grow in it.

In high schools across the country, young people with a bent for

applied science are inventing and producing things such as ultrasonic guides for the blind, cyclotrons, piezoelectric clocks, biochemical fuel cells, light-activated vehicles—you name it. All are members of something called the Junior Engineering Technical Society (JETS for short)—a booming organization of some 30,000 young science-oriented enthusiasts located in more than 3,000 high schools scattered from coast to coast.

The unique program was born in 1950, in the back yard of Prof. Harold P. Skanser, then teaching in the Michigan State College of Engineering. Skanser, who'd spent years talking to high school seniors in an effort to steer them into engineering and the sciences, found that most of the interested and likely candidates couldn't qualify because they hadn't taken enough math or drudging basic science courses. His first JETS "club", designed to catch young high-schoolers early enough to steer and advise their enthusiasm, was made up of science and math students in East Lansing High. It was a huge success. More than half the club members went on to engineering and technical schools.

With the help of his dean, Lorin Miller, and the sponsorship of Michigan State, Skanser set out to start more clubs in more high schools around the state. Built on the format of the 4-H clubs, JETS elected their own officers but worked under the guidance of a faculty adviser called a "pilot." Members de-

veloped and built practical scientific or engineering projects, competed in science fairs and engineering expositions. Industries were invited to support the clubs with money, scholarships, prizes, technical data and equipment. Many did.

By 1959, JETS units were established in 365 chapters in 35 states. Michigan State's local project had burst its seams, and the present national organization was formed as a non-profit society. Today it is under a full-time executive director, David Reyes-Guerra, who works out of New York. He is a graduate engineer, reporting to an aggressively active board of directors representing education, big industry and government. J. D. Ryder, dean of Michigan State's College of Engineering, is president of the society and still maintains national headquarters in East Lansing.

And it is still growing. Out of Reyes-Guerra's office goes a nine-issue-per-year *JETS Journal* filled with chapter news. Club "starter packets" flow out to new schools in a steady stream, filled with instructions and advice on how to organize and run project expositions, "engineering downs", field days, career forums and assemblies. An "engineering down" is a favorite JETS intra-chapter competition described in the literature as "the engineering counterpart of a spelling bee." Teams are selected to represent each chapter and win points for correct answers to hair-raising mathematical and technical questions.

Nowadays, more than 50 major

businesses, industries and societies contribute to the JETS program. Many are behind the growth of new chapters. When an aviation company was scouting universities for young engineers some years ago, their chief of Engineering Training heard about the JETS program when he visited Michigan State, and sold his bosses on the idea of promoting JETS chapters in all the high schools in the area of their plant—some 12 of them. The company granted \$100 per year per chapter to get them rolling, and provided more than a dozen engineers and scientists, part-time, to wheelhorse the operation. "We needed engineers," they explain candidly. "So we decided to help the schools find and develop them."

Real success story

Just how successful the program is was demonstrated in a recent poll of a 50-member chapter in Springfield, Mass. Every member of the group planned to go on to college. "There's hardly a JET in the program today," says Reyes-Guerra, "who can't get into an engineering or technical college if he wants to."

Most ordinary citizens sitting in on a meeting of one of these clubs, would feel like fossil-fuel-era dropout. The sophistication of the young scientists and their projects is often nothing short of nervous-making. At a gathering of the Oceanside, L.I., High School chapter, I listened to a lengthy dissertation by Robert Sasson (the computer programmer



Dale DuBois of Pomona, Calif., devised a new principle for thin film coating which he calls "Thin Film Sputtering." He prepared his project for a Regional JETS Projects Exposition at the California State Polytechnical Institute, one of many JETS exhibitions.

mentioned earlier) on his theory of light reflection values from color samples. Following the technical talk, he demonstrated a device he was perfecting, utilizing two photo cells in parallel to measure the quantity of reflected light from color swatches. "It may be useful in color photography, and for matching paint colors," he said blandly. This discussion was followed by others on subjects such as solid state circuitry, hydrodynamics, computer game theory and rocket stage systems. I have attended professional scientific symposia and listened to papers that were far less astutely and professionally rendered. Or as sensible.

Faculty advisers of JETS chapters learned early in the game that

their charges were not interested in building trick electrical gadgets, toys or juvenile devices for demonstrating minor physical phenomena.

One chapter at Memorial High School in Levittown, N.Y., decided that their school needed a genuine cyclotron for genuine nuclear collision studies in the 14MEV (14 million electron-volts) range, and that they would build it. They did, and it works. They drew their plans after consultation with top experts all over the country, read everything they could find on the subject, had engineers check them over, and wheedled an aviation company into providing the large, precisely machined magnetic core—the expensive heart of the machine. The

(Text continued on page 78)



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job took three years and several generations of chapter members, under the guidance of a dedicated science teacher, Marvin Feinstein.

While most JETS members enter their projects—individual as well as group—in many local and national science fairs and expositions, the big events are the annual Regional Jets Projects Expositions. This year there were three of them, held in Waltham, Mass., at Texas A & M University in College Station, and California State Polytechnical Institute in Pomona. More than 1,000 people attended the Texas conference, including 700 JETS who delivered papers like prize-winner Wayne Hibbs' "Study of Patternology".

Prize-winning projects in the Waltham Exposition included an

array of astutely devised metallurgical tools for astronauts, invented by Elaine Martin, from Boston's Gate of Heaven High School; and a highly original Lunar Surface Study, presented by Joseph Borg of Fresh Meadow, N.Y.

In Pomona, Dale DuBois came up with a new principle for thin film coating, which he calls "Thin Film Sputtering"; young Gregg Caringella built a laser for use in holography, which he demonstrated.

Because of the growing importance of the JETS program in the furtherance of science and technology, *Science Digest* will devote several pages each month to outstanding JETS projects, with plans and instructions for building those that may be useful to science teachers, students and hobbyists.



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ACCREDITED MEMBER, NATIONAL HOME STUDY COUNCIL

Airplanes that land on a doughnut

TOMORROW'S PLANE may come equipped with built-in "life-jackets," enabling them to slide in for landings on any surface, if a newly-developed Air Cushion Landing Gear (ACLG) is adopted for commercial and military craft.

The system uses the air cushion principle, rather than wheels or pontoons. The underside of the aircraft is fitted with an elastic air cushion bag that receives air from an axial fan powered by a small gas engine inside the fuselage.

In flight, the doughnut-shaped bag retracts snugly against the airplane. For landings and take-offs, the bag is inflated by the fan. Hundreds of jet nozzles at the bottom of the bag feed air inward toward the "hole" of the doughnut, producing an air cushion under the plane that holds it off the ground—or water.

After landing, the plane's forward speed is checked by reversing the propeller pitch. For final braking, the air cushion bag's rubber-

ribbed tread is brought into contact with the ground by a braking control.

The ACLG has several important advantages over ordinary landing gear systems: It needs no hard-surfaced runway, since an air cushion spreads the aircraft weight over a large area. Thus, the ACLG airplane can use open water, ice, snow, swampland, sand or dirt for its runway.

Another advantage is the safety factor in having an air cushion "lifejacket" for planes forced down over water.

In an emergency, bulldozers could rough-grade an airstrip and giant cargo planes fitted with ACLG could begin landing immediately, utilizing valuable time.

Textron's Bell Aerosystems Company, which has patented the ACLG concept, has been working on the system in a company-funded research program that began in 1963.

Preparing to land, the doughnut-shaped Air Cushion Landing Gear attached to the bottom of the plane is inflated to allow the pilot to alight on ground, water, ice or swamp.



Send documents by telephone

Idea of the Month

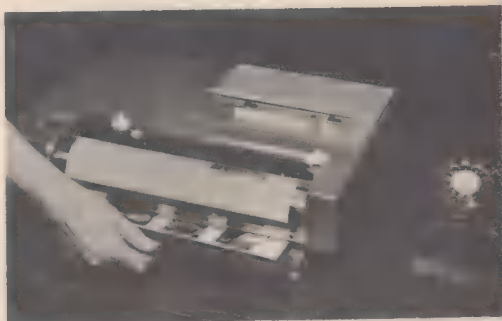
A NEW INSTRUMENT about the size of a portable typewriter makes it possible to send and receive documents over any office or household telephone. The transmission is by acoustic tone—that is, sound waves—and makes attachment of any wires to the telephone unnecessary.

Graphic Sciences Corporation, Danbury, Conn., expects to begin distribution of its graphic transceiver late this year. A businessman talking to a prospect in another city will be able to interrupt the conversation, send a facsimile of the sales contract they have been discussing and resume the conversation.

Prototypes of the machine have been built and tested. When produced for sale, it will be about 21 by 14 by 5 inches and portable. A connection plugs into an ordinary household alternating current outlet.

According to Robert Dombrowski, president of Graphic Sciences, a full page can be transmitted line by line in six minutes. If the copy is shorter, the time is proportionately less.

The document to be sent is wrapped around a drum of the originating transceiver. The sender makes sure the recipient is ready,



Full-page documents can be sent over ordinary telephones now—by way of the newly patented graphic transceiver, above.

puts his handset into a recess in the instrument and throws the “transmit” switch.

The recipient wraps a sheet of electrosensitive paper around the drum of his machine, sets his switch in the “receive” position and puts his handset into a recess.

A patent (3,392,232) was recently issued for the transceiver, but the project was already well advanced. The inventor, Milton S. Cohen, an electronics engineer, had assigned the patent to Arthur D. Little, Inc., a large research and engineering firm in Cambridge, Mass. Little sold the world rights to Graphic Sciences for \$500,000.

The transceiver is the first in a line of information appliances that Graphic Sciences has planned. Its business also includes computer language for special purposes such as making airline reservations.

—Stacy V. Jones

Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the Science Digest staff.

Subatomic 'bullets'



Why are scientists finding so many new subatomic particles, and what is their significance?

The key to the answer of this question lies in one phrase: "More energy."

Physicists study the inner structure of the atomic nucleus in a very crude way. They hit it with all their might with subatomic particles, smash the nucleus into fragments and then study the pieces.

What has changed over the last 30 years has been the energy with which the tiny subatomic "bullets" are sent smashing into the atomic nucleus. In the 1930s, those bullets had energies in the millions of electron-volts; in the 1940s, in the hundreds of millions; in the 1950s, in the billions; and in the 1960s, in the dozens of billions. It seems that in the 1970s we will probably have bullets that number in the hundreds

of billions of electron-volts.

The more energetically the nucleus is smashed into, the greater the number of particles that emerge and the more unstable they are. You might suppose that as the smashes grow harder, the emerging particles will be smaller. (After all, a hard smash will split a rock into two large pieces, but a harder smash will split that same rock into a dozen small pieces.) This is not so in the case of nuclei. The particles that emerge tend to be quite heavy.

Energy, you see, can be converted into mass. The subatomic particles that appear in an atom-smashing process are not knocked out of the nucleus as though they were there all along. They are formed at the moment of smash out of the energy of the smashing particles. The greater the energy of the incoming particle, the more massive the particle that can be formed, and usually the

more unstable the particle.

In a sense, subatomic particles go flying out of smashed nuclei, the way sparks fly off steel struck by flint. The sparks weren't in the steel to begin with; they were formed out of the energy of collision.

But in that case, is there any significance to all these new subatomic particles? Might they not just be the random products of energy as sparks are?

Physicists don't think so because there's too much order among them. The particles that are formed have certain properties that obey certain rather intricate rules. That is, the various particles can be represented by numbers that are identified by names such as "isotopic spin," "strangeness," "parity" and so on, and the nature of the numbers is dictated according to certain rigid limitations.

There must be something behind

these limitations.

The American physicist, Murray Gell-Mann, has worked out a system of arranging the various subatomic particles according to these various numbers in regular progression, and in doing so has been able to predict new and hitherto-unknown particles. In particular, he predicted the existence of an omega-minus particle with certain unlikely properties—but when it was looked for, it was found, and with just those properties.

Gell-Mann also suggests that the hundreds of particles now known would naturally be arranged in the fashion he has shown if they were all built out of a very few kinds of still simpler particles he calls "quarks." Physicists are hunting for quarks now. If they are found they may offer us a completely new view of the fundamental nature of matter and, just possibly, a vastly useful one.

—Isaac Asimov

If the Columbia Plateau in Oregon was formed by lava from a volcano, why is it flat?

Not all volcanoes are the cone-shaped, violently exploding type associated with Hollywood's tropical paradise movies. While it is true that many volcanoes—such as the ones that form a "Ring of Fire" in the Pacific Ocean, the great mountain of Fujii in Japan and the Cascade Range in the American Northwest—are cone or shield-shaped, volcanic action takes place in many

ways. The earth formations they leave behind are just as various.

The Columbia Plateau is a result of the flow of volcanic lava that escaped from fissures or cracks in the surface rock strata 20 to 25 million years ago. The lava, being very fluid, was free to flow without obstruction. Basalt, as this type is called, engulfed about 175,000 square miles of Washington, Idaho, Oregon, Montana and Nevada.

Spreading sheetlike over an enormous area, entire geographical regions were entombed under hun-

Does Your Memory Fail You?

A noted publisher in Chicago reports there is a simple technique for acquiring a powerful memory which can pay you real dividends in both business and social advancement and works like magic to give you added poise, necessary self-confidence and greater popularity.

According to this publisher, many people do not realize how much they could influence others simply by remembering accurately everything they see, hear, or read. Whether in business, at social functions or even in casual conversations with new acquaintances, there are ways in which you can dominate each situation by your ability to remember.

To acquaint the readers of this publication with the easy-to-follow rules for developing skill in remembering anything you choose to remember, the publishers have printed full details of their self-training method in a new booklet, "Adventures in Memory," which will be mailed free to anyone who requests it. No obligation. Send your name, address, and zip code to: Memory Studies, 835 Diversey Parkway, Dept. 690-010, Chicago, Ill. 60614. A postcard will do.

dreds of feet of the hot, glowing fluid. No cone or shield was formed because the lava did not solidify at its source.

But if the consistency of the lava had been more viscous or thickened, the possibility of violent explosions would have been more likely. It is only under such circumstances that cone formations are produced.

In certain cases, cone-shaped volcanoes become so violent that they actually destroy themselves. The pressure that builds up behind the viscous lava lets go in a frenzied burst of fire and rock. And when the smoke and volcanic ash clears, a whole mountain may be gone.

This very thing happened to the volcano on the island of Krakatoa in Sunda Strait between Java and Sumatra in 1883. This island with a diameter of five miles has been reduced to three tiny islands by eruptions that literally blew it out of the sea. The noise was heard 3,000 miles away, and hundreds of tons of ash and fine pumice were blasted into the air. Scientists have estimated the amount to be as much as five cubic miles of volcanic particles.

So dense was the great cloud of ash that the sky was darkened at a distance of almost 300 miles, and the particles fell on ships as far away as 1600 miles. Two years after the eruption, the world was still experiencing spectacular red sunsets caused by the straggling particles carried along on the winds of the upper atmosphere and scattered to all points on the globe.

QUIZ



Rod-like strands of tobacco mosaic virus can be seen only through powerful electron microscope.

It's only a virus

by John and Molly Daugherty

BUT WHAT A VIRUS! A small test tube of compound polio viruses in crystalline form is enough to infect everyone on earth except for those who are immune. A single polio virus infecting one cell in man may produce thousands of new viruses in a few hours. Millions of them close together would show up as a tiny speck.

What do you know about viruses?

1. In 1935, Wendell Stanley prepared the

first sample of a pure virus in crystalline form. This virus was

- a. Flu (influenza)
- b. Tobacco mosaic
- c. Polio (poliomyelitis)

2. Most common compounds in the earth's crust, the oceans, and the atmosphere contain only a few atoms in their molecules. Water and silicon dioxide contain only three atoms. The giant molecule of tobacco mosaic virus contains about
- a. 250,000 atoms
 - b. 1,250,000 atoms
 - c. 5,250,000 atoms

3. Viruses can reproduce or replicate themselves

- a. Only within living cells
 - b. As bacteria reproduce
 - c. Outside the cell of the host
4. Any specific type of virus infects only a limited variety of living cells. Viruses attack
- a. Only single-cell organisms
 - b. Only plants and animals
 - c. Single-cell organisms, plants and animals
5. Not all viruses are harmful. Among more than 300 plant viruses known today, the oldest one is
- a. Abutilon mosaic
 - b. Tulip mosaic
 - c. Cucumber mosaic
6. A virus needs transportation to the host cell. Insects often play this role, and sometimes man does so in his activities. If you are a smoker, especially a pipe smoker, you may infect your garden
- a. Onions
 - b. Carrots
 - c. Tomatoes
7. If you have plants such as privet, delphiniums, dahlias or a number of other ornamental plants in your garden, you may have trouble growing cucumber vines because of a virus carried by
- a. Aphids
 - b. Bees
 - c. Mosquitoes
8. In 1933, influenza (known for centuries) was identified as a virus infection. The flu epidemic of 1918 and 1919 killed an estimated 20 million people. The flu of 1940 was different and labeled type B. The Asian flu of 1957, a different variant, would not respond to type B vaccine. The cause of the changes in the flu viruses is
- a. Resistance in the host cells
 - b. Mutations in the replication of viruses
 - c. A completely different set of amino acids in the protein component of the virus

9. Although all viruses are not alike and do not have the same percentage composition, viruses essentially are
- a. Protein and nucleic acid
 - b. Protein and lipids
 - c. Nucleic acid and lipids
10. The electron microscope is an essential tool for studying viruses because of their small size. A technique developed in 1946 produced a 3-dimensional effect. This technique used
- a. Ultra-thin sections
 - b. New staining methods
 - c. Metal shadowing

Answers:

1—b Tobacco mosaic. Stanley wanted to find out the chemical nature of the virus and to isolate it. He used about a ton of tobacco leaves. He ground up the leaves and extracted the juice from them. From the filtrate he succeeded, using precipitation methods and an ultracentrifuge, in obtaining needle-like crystals of pure virus in sufficient quantity to fill a spoonful.

2—c 5,250,000 atoms. With few exceptions viruses are too small to be seen under optical microscopes, but can be seen with an electron microscope. It would take one million-million-million polio viruses to fill a ping pong ball.

3—a Only within living cells. In the dry crystalline state, viruses are like inert material, but when they infect a living cell (only part of the virus—the nucleic acid enters), their active life may last for as little as 13 minutes and at the most only a few hours. In the cell the virus takes command and forces the cell to produce

replicas of the virus in great number. Copying errors or mutations may occur, too. These are viruses unlike the parent virus.

4—c Single-cell organisms, plants and animals. Polio infects man and only a few animals. Bacterial viruses attack bacteria, and because they are convenient to handle in the laboratory, have afforded vast information about viruses. The same is true for the plant virus tobacco mosaic. In 1960, it was the first virus for which man in a lab situation built an hereditary change into a virus.

5—b Tulip mosaic. This virus causes color changes in the tulip flower producing beautiful variegations and also pencilings. The effect is called "tulip break." It appears in tulips shown in paintings of the 16th and 17th centuries. These tulip bulbs (now known to be caused by a virus) commanded very high prices. Stories tell of a bride considered desirable because her sole dowry was a valuable tulip bulb.

6—c Tomatoes. Tobacco mosaic virus is very stable, and most commercial tobacco brands retain this potential infectivity. So a smoker handling his tomato plants may inadvertently infect them with this mosaic virus.

7—a Aphids. One or more species of aphids may carry the cucumber mosaic virus from other plants to the cucumber vine. Incidentally, the cucumber mosaic was the first virus to be transmitted by the aphid vector in a laboratory experiment. Insects which transmit viruses are called vectors.

8—b Mutations in the replication of viruses. In 1918 a new strain of the flu (not known to be a virus at that time) appeared when a *small* change in the structure of the virus produced a mutation. This mutant was more deadly than the common and relatively mild flu up to that time. Still further mutations occurred in 1940 and 1957.

9—a Protein and nucleic acid. (Often referred to as a nucleoprotein molecule). In some of the larger viruses lipids are also present. There are two varieties of nucleic acid. One containing the sugar ribose is called RNA (ribonucleic acid) and is present in polio, flu and tobacco mosaic viruses. The other, containing the sugar deoxyribose, is called DNA (deoxyribonucleic acid) and is present in all the bacterial viruses that we know of. Some animal viruses contain RNA; others, DNA.

10—c Metal shadowing. Various metals, evaporated in a vacuum from a heated filament, sent a stream of metal atoms toward the specimen. At selected distances the metal atoms arrived in nearly parallel lines. Being metal they are more opaque to the electron beam and thus cast a shadow. The three-dimensional effect helps reveal structural details of the virus not seen before.

Score yourself:

9—10 right—You're infected with knowledge.

4—8 right—You had the germ of some ideas.

0—3 right—Don't let this bug you.

A Doomsday prediction

The Biological Time Bomb. By Gordon Rattray Taylor. New American Library; World Publishing. (\$5.50)

The Doomsday prophets will be with us always, which is probably a good thing. History is rife with accounts of civilizations and animal species that have skidded to oblivion on their own "progress" and "success." Advanced warnings of the chasms ahead can, theoretically, change the course of a precipitous trend—if anyone pays any attention to them.

Mr. Taylor is sounding the alarm. There is a Frankensteinian monster in our midst, he says—a pulsating blob of chemical protoplasm of our own concoction that is already "going critical." Unless we prepare to deal with it, the monstrous thing will surely destroy us.

Where are the biologists—those once fusty and harmless dissectors of salamanders and frogs—taking us, he asks; then proceeds to answer the question. And the tally is hair-raising, when you add it up that way.

He starts with a review of the scary (and successful) work of Steward and Lederberg in organism duplication by "cloning" of cells, which brought forth the headline: "Einsteins from Cuttings!" Steward did it with carrots, but Lederberg talked about "cloning people." At

Oxford, J. B. Gurdon recently took the nucleus from an intestinal cell of a frog, put it in an unfertilized frog egg and came up with tadpoles.

Gurdon's work, says the author, holds the possibility, "*right away*, of producing exact copies of prize bulls, race-winning horses, or exceptional human beings."

Who would such people be, he asks? What would be their legal rights?

Everyone knows that organ transplants are with us *now*. The question of when a person is legally dead has already been posed. Not everyone knows that Etienne at the Collège de France has grown embryonic tissue destined to become particular bones, skin and testes; has switched the sex of gonadal tissue and is now growing eyes.

This tinkering with heredity by way of genetic secrets; the frightening work in hormones that provides man full control over human intelligence, physical and mental defects; the threat of man's ability to produce superman is no longer the figment of the science fiction writers' free-wheeling imaginations. It is here, *now*.

The implications are, of course, fantastic. And the author wallows in them. "Biology is about to present us with a vast range of situations for which we have no accepted social responses. (How should one greet a cyborg?)"

What Mr. Taylor has done here is to prove the prophetic and dire warnings of people like Jean Rosstand, with well documented evidence of modern achievement. The picture he paints in his conclusion is a real hell on earth, when (not if) irresponsible people, power-mad dictators and sinister folk among us, use the great body of biological knowledge to further greedy ends.

What he does not take into account is the prescience of mankind—exhibited throughout history—in coping with impending cataclysms.

While there have been many “cliff-hangers” down through the ages, the fact is that people have—somehow—managed to isolate and contain the cancers before they destroyed the organism.

Perhaps the credit can go to pushers of the panic button, like Mr. Taylor. He has done a remarkably fine job, sticking to solid facts in actual research and projecting only the time when each shuddering development will be upon us. The book may scare you. But it's well worth reading.—RFD

Other new books of interest

The Evidence of Evolution. Nicholas Hotton III. American Heritage Publishing Co., The Smithsonian Library. (\$4.95). All the evidence is here, and it's put together beautifully and thoroughly, as might be expected. Besides the outstanding pictures and artwork, extras include assorted appendices ranging from a timetable of evolution to a prehistoric who's who.

The Story of Jodrell Bank. Sir Bernard Lovell. Harper & Row. (\$5.95). Here is the story behind the creation of the world's largest radio telescope and the story of the emergence of radio astronomy as a new science.

Honeybees From Close Up. Arthur M. Dines. Photographs by Stephen Dalton. Thomas Y. Crowell Co. (\$6.95). The author's lifetime of

study of the bee, as well as expert close-up photographs of the honeybee from egg to adult make an attractive and informative volume devoted exclusively to the whys and wherefores of this complex insect.

The Right Size. Hal Hellman. G. P. Putnam's Sons. (\$3.49). Why creatures have come to be the size they are and how successful evolution of a species depends on its adjustment to many environmental factors is this author's story. It seems that the dinosaur is extinct because he was too large in a changing environment, but man has survived because he is just the “right size.”

Kilauea: Case History of a Volcano. Don Herbert and Fulvio Bardossi. Harper & Row. (\$5.95). Volcanic eruptions have always fascinated man, and scientific teams are now

Why Do You Read So Slowly?

A noted publisher in Chicago reports there is a simple technique of rapid reading which should enable you to increase your reading speed and yet retain much more. Most people do not realize how much they could increase their pleasure, success and income by reading faster and more accurately.

According to this publisher, many people, regardless of their present reading skill, can use this simple technique to improve their reading ability to a remarkable degree. Whether reading stories, books, technical matter, it becomes possible to read sentences at a glance and entire pages in seconds with this method.

To acquaint the readers of this publication with the easy-to-follow rules for developing rapid reading skill, the company has printed full details of its interesting self-training method in a new booklet, "How to Read Faster and Retain More" mailed free to anyone who requests it. No obligation. Send your name, address, and zip code to: Reading, 835 Diversey Parkway, Dept. 690-010, Chicago, Ill. 60614. A postcard will do.

trying to get a precise picture of what goes on inside a volcanic eruption in order to predict when such an event is likely to occur. Some outstanding pictures highlight the story, which is the first of four books based on "Experiment," ■ series of programs shown on National Educational Television.

The Population Bomb. Dr. Paul R. Ehrlich. Ballantine Books. (\$95 paperback.) "While you are reading these words four people will have died from starvation. Most of them children." Dr. Ehrlich's point is made in the above statement, but he enlarges on the enormity of the problem of overpopulation and what it is doing to the world. There is much frightening food for thought contained in these pages.

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Up to date sleep learning

I read the article on sleep learning published in the March '68 issue of *Science Digest*. The report is quite informative in its content, but it missed the main important factor as a start—sleep learning techniques are applicable to support daytime study.

From my point of view, the article is not quite up to date, as the notions mentioned in D. Curtis' book were overruled a long time ago.

Sleep learning on its own is a very interesting item for the investigator working in the psychological laboratory, but in practice or applied-wise, it has to be combined with daytime study. As the practical (working) method of sleep learning is a type of distributed learning against mass learning, it is divided into two main tasks. The first task is preliminary hypnopaedic training during drowsiness and light sleep to influence the second task, which is relearning in the classroom, language laboratory or by using teaching machines for programmed learning during the day. The scientific fundamentals are based on the "transfer" effects stemming from the first task to the second task. Saving in learning time of the second task, i.e. daytime study, is one of the practical promises of the sleep learning method.

It is a pity that your article did not

mention original learning and re-learning (Ebbinghaus) in more detail, because this is psychologically quite significant.

From the article I have to conclude that not much is known generally in the U.S.A. about sleep learning. Publicity, distributed by commercial organizations without academic backing, caused considerable harm to the subject, and it is quite a struggle to rectify the false lines.

I am in personal contact with the academic authorities involved in the experiments conducted in Dubna and also with other scientists of the USSR. Their work is published in our journal and a very interesting book by a Russian scientist is also under the process of publication.

F. RUBIN

The Sleep Learning Association
London, England

LSD credibility gap

Your article, "LSD and broken chromosomes," (April '68) performed a service to your readers by informing them as to the work at two institutions—the State University of New York at Buffalo School of Medicine and the University of Iowa. To round out the picture, mention should be made of the work at Temple University's Medical School, where large doses of pharmaceutical LSD (rather than black market, impure LSD) were given to non-psychiatric (rather than schizophrenic) subjects, and blood samples taken (rather than having the LSD mixed with test tube blood.) No unusual incidence of chromosomal breaks were found. Other evidence, in recent issues of *Science*, emphasizes the point that

adults who use the "chromosome scare" to keep young people from taking LSD may be correctly accused of a credibility gap. Although I oppose the illegal use of black market LSD, I am also opposed to jumping to conclusions on the basis of tentative and conjectural data.

STANLEY KRIPPNER, PhD
Maimonides Medical Center
Brooklyn, N.Y.

Cantonese harder than Mandarin

In the "Sleep learning" article in your March '68 issue, I noticed a quote from David Curtis' book, "Sleep and Learn," wherein he stated Mandarin Chinese is the most difficult language to learn. If he would check with some linguists he would find that perhaps that is not true. I have studied and can speak Mandarin Chinese and Cantonese Chinese. Cantonese is by far the more difficult of the two.

DOUGLAS McOMBER
Fremont, Calif.

A water witching experience

After reading the article in the January '68 issue of *Science Digest*, "Psychologists examine the 'secrets' of water witching," by Ray Hyman and Evon Z. Vogt, I feel led to write of my own experience in this matter, and give you my explanation of how it works.

I am the third generation of males in my family who has had this gift of locating water veins in the ground. I have used this gift in a very practical way to aid my neighbors, friends and others who have come to me for

this purpose. Without fail I have had success in finding veins of water sufficient for their needs.

I do not consider this gift anything magical, but a phenomenon of nature. There are some people with whom the crotched sticks do not seem to work. I contend that one has this gift or does not have it on the basis of one's susceptibility to electric power or magnetism. In using a green forked stick to find a vein of water, the surface of the ground is the negative pole of the magnet, and water, being a good medium for electric power, acts as the other pole (as on a battery). This completes the circuit of electric current from the upper surface through one's body and back to the deeper layers of earth

where the water is in contact with greater deposits of mineral elements. This latter constitutes what we might call the positive pole.

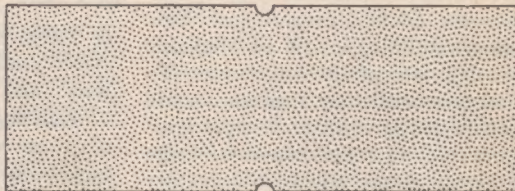
Consistent with this explanation, I have found that it seems to make quite a difference as to what I wear on my feet when I am using the sticks. Rubber soled shoes and rubber boots seem to greatly diminish the pull of the stick downward. Wearing leather shoes or boots or going barefooted, I get a strong pull of the stick in the same place. Rubber acts as an insulation and may be the reason why some people have failed to do anything with the crotched sticks or divining rods.

MYRON H. PACKARD
Dryden, Maine

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Keystone

Miss Muffet, where are you ?

DEADLY poisonous spiders don't usually produce the look of affection that appears on this London zoo keeper's face. But he claims to know how to handle *Grammastola Mollicoma* specimens safely.

This spider is a native of Brazil; and its diet consists mainly of birds, though she does occasionally eat other things—like her own mate.

Her method of obtaining food is

to puncture her prey with fangs and inject an enzyme into the wound, making the tissue change into a liquid state. She then pumps her prey dry.

Spiders shouldn't be confused with insects, which are members of a separate class of the phylum Arthropoda. Spiders belong to the class Arachnoidea; insects belong to the class Insecta.

In this issue . . .



NASA's new Radio Astronomy Satellite has an antenna that is 1500 feet tall when it's extended. That's taller than the Empire State Building. See page 38 for the whole story.

Certain Scandinavian eyeballs have been bulging recently because of Pucki, a black poodle who prefers to walk upright instead of on all fours. Doctors tell why on page 72.

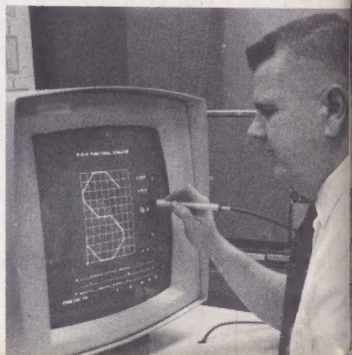


Ancient man-made caves have been discovered in several New England states. Some theories say they were Viking-made; others say prehistoric Irish. You can decide for yourself on page 35.



Not exactly comfortable, but a boon to soldiers, hunters and other outdoor workers, this lightning tent (left) can withstand severe static electricity charges. See it and other "New for People items," page 22.

Visual characters are electronically produced on a TV-like tube (right) and activated by spoken words. IBM developed it, and it appears with other innovations in the world of industry on page 56.



Ulcers can be cured, but doctors still really can't figure the ailment out. Is it nerves; is it hormones? The doctors' dilemma is on p. 30.

Russian scientists are showing some of their space achievements at an exhibition in Rome, Italy. See as the Romans see on page 66.

